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THE LA CROSSE HYDROELECTRIC PLANT.

Elsewhere in our columns we give an account of one of the typical hydroelectric plants of moderate size, which are gradually revolutionizing electrical distribution. The time has now come when every available power within striking distance of the city market is being taken up for development. The system before us transmits energy to three cities for general purposes, beside furnishing electricity to a large manufacturing town which is growing up near the generating station in order to take advantage of the cheap energy furnished. The hydraulic installation is simply a solid piece of construction without any sensational features. A high dam of monolithic concrete on a ledge foundation backing up a good storage pond, a canal between two and three miles in length with head works and forebay at its end, and a compact and simply-equipped power house make up the characteristic features of the plant. The present installation is of 8000 effective horse-power in two units. The small number of units is characteristic of many of the recent stations. A few years ago a plant of this size would have had at least four units, but the experience of the last decade has shown very plainly that the reliability of the generating plant as now built is so great that the subdivision once thought necessary need no longer be practiced. In point of fact, the simple direct-coupled hydroelectric plant of this kind is extraordinarily reliable. If the hydraulic works are so constructed as to give no trouble from anchor ice or low water, and the line is a thoroughly good one, one need worry very little about the power house.

The total length of the transmission lines in this case runs to about 77 miles all told, of which about two-thirds is steel tower construction and the remainder of wooden poles. It is worth noting that both tower lines and the wooden pole lines are single circuit. For high-voltage construction there is something to be said for this practice. Two high-voltage circuits on the same pole or tower line do not give a large measure of security above a single circuit on account of the probability of both circuits being involved in any serious line trouble. When the time comes for more lines, a complete duplicate line is so much safer than any single line carrying several circuits as to be well worth the while. The circuits of the La Crosse system are worked at 46,000 volts between wires operated with grounded neutral. The spacing between the wires is somewhat larger than is customary for this voltage, the wires forming an equilateral triangle 6 ft. on the side, a space which gives opportunity of raising the voltage higher if at some future time it should seem desirable. The insulators are of the ordinary pin type with a considerable factor of safety, though a voltage of 46,000 is getting up near to the point where suspension insulators are desirable. The distribution accomplished from this plant includes the delivery of electricity to the local company at La Crosse, the supply of energy to the Winona Power & Lighting Company, general distribution to Onalaska,

Wis., and heavy power load at Vaudreuil, Wis. The motor service on the system is a particularly heavy one, including several large flour mills, which are heavy consumers for 24 hours a day and six days per week; and these large users, combined with much motor service in smaller units, gives an exceptionally good load factor to the plant. Added reservoir capacity has been given the system during the last summer and further storage is in sight, marking well the recent tendency toward the better appreciation of the value of reserve water.

COMMUTATION.

It ordinarily happens in the manufacture of any machine, apparatus or device, that practice goes ahead of theory. The pioneer designers and builders set themselves to produce. They have to develop certain required conditions and to avoid certain objectionable features. They understand, at first, but dimly, the relations that favor the good qualities or that suppress the bad. They cannot take the time to investigate, but go bravely to the attempt. Often the attempt fails; the machine will not meet requirements. If so, there is nothing but to try and find out the immediate source of failure, and to make the next attempt with that source removed as far as possible. Taught by experience in this way, constructors learn what to include and what to omit in their designs. They arrive empirically at a certain measure of success. Empirical success is, however, necessarily based on narrow foundations. Any change in the structure is apt to throw the center of gravity beyond the base with disastrous results and expensive reconstruction. Gradually, theory follows in the wake of construction, and indicates the reasons and limitations of restriction in each direction, so that designers slowly come to understand not merely what they must do to succeed, but also why, and just how far, they can go without failure. The success which they finally achieve is thus no longer empirical, but rational and secure. How long it takes for theory to overtake practice, even superficially, depends upon the complexity of the structure, as well as upon the development of physics and mathematics in the directions where the structure comes into contact with the fundamental data of acquired knowledge. Even in the simplest machines theory is usually only able to give temporary satisfaction for practical needs. The more is needed, the less adequate the theoretical basis proves to be. In complex machinery, theory at the present time makes no pretense to have reached, even with its advance guard, the main body of practice.

The phenomena of commutation in direct-current machinery are very complicated. As each commutator segment in turn separates from the tip of the superposed collecting brush, the current through the brush must disappear. If the potential difference between the two is less than a certain amount, the disappearance will be uneventful, and the current will be handed over to the next commutator segment without any disturbance. If, however, the critical potential difference is exceeded, the current continues in the form of an arc after mechanical contact between the segment and brush has been severed. If, further, the critical value is much exceeded, the arcing will be sufficiently powerful, prolonged, and hot, to erode the commutator badly, or even to stop the operation of the machine. The object of the designer is then to keep the potential difference at rupture down to the required limits. It is known that this may be done either by impressing a suitable commutating e.m.f. upon the coil connected with the opening segment, or by checking the current through that segment before rupture with the aid of increasing resistance in the brush tip. The former method is commonly called voltage commutation, and the latter resistance commutation. The cyclic conditions of reducing the current to zero at each segment opening are so complex that designers are forced to be content with empirical formulas based partly upon theory but mainly derived from experience.

Mr. F. W. Carter makes a noteworthy contribution, this week, to the theory of commutation, along the lines of both voltage and resistance methods in his article on page 804. He points to the probable reason for the well-known variation of commutation oscillographic records, namely, the continually varying contact resistance of the brushes. The gist of the algebraic reasoning in the article is that the time of commutation—that is, the duration of the short-circuit of each coil under the brush—must exceed the effective time constant of the coil, namely, the ratio of the inductance of the coil, including mutual induction of its neighbors, to the effective resistance of the brush contact with the separating segment. If the time of commutation is less than this time constant, the current density tends to rise indefinitely in the tip of the brush, with a spark, at rupture, as the result. If the time of commutation is greater than this time constant, the current density in the tip will have a chance to drop quietly to zero. The formula for computing the time constant for any given machine is, however, very long and unwieldy, so that it is doubtful whether the formula can have much practical application. Serrating the tip edge of the brush seems to be new, and appears to be promising, although a setting out of parallel with the segments—a somewhat similar device—has been used with some success.

SOME MAGNETIC STORM RECORDS.

It has long been known that the magnetic condition of the earth, although in the main steady, is subject to a number of fluctuations. There are long periods of fluctuation extending apparently over centuries. Then there are periods less long, corresponding to 11-year sun-spot periods. Next, there are annual fluctuations. On top of these are daily fluctuations. Over and above all these tides in the great ocean of the earth's magnetism, there are perturbations going on continually with occasional violent storms. Certain of the fluctuations are clearly connected with solar actions, as, for instance, the diurnal fluctuation that follows the sun's angular position with respect to any particular station on the earth's surface. Certain perturbations and magnetic storms are likewise manifestly associated with the sun spots, and perturbations of the solar surface. These magnetic storms are also accompanied by marked differences in the electric potential of different parts of the earth's surface, which again give rise to "earth currents" in telegraph and telephone conductors. As mentioned in the Digest, the London *Electrician* of March 11 publishes some comparative records of earth currents on a broken Atlantic cable, and of simultaneously registered magnetic elements at four observatories. The cable runs nearly east from Cape Cod, Mass., and was broken in July, 1898, about 1600 miles from that station, thus making ground in mid-Atlantic. A continuous record of earth currents, for 16 days together, showed a diurnal e.m.f. in the cable of some five volts alternately positive and negative, making two cycles a day, like an ocean tide, but with a more disturbed contour than a simple tide recorder usually gives. At midnight of July 19-20, Cape Cod time, or about 5 a. m. Green-

wich civil time, the earth e.m.f. in the cable reached a maximum of 33 volts, the peak of the disturbance being well marked, and the entire disturbance lasting about two and one-half hours.

An examination of the photographic records for that time among the magnetic observations in the observatories of Greenwich, Paris, Kew, and Stonyhurst, clearly shows a well-marked peaked disturbance in declination, either at, or a few minutes before, 5 a. m. Greenwich civil time. All these disturbances had like direction. A similar disturbance was evident in the horizontal force records, although not in the vertical force records. The origin of these electric and magnetic perturbations is more or less speculative. It is possible that a column of finely divided electrified matter might be thrown at the earth from a solar eruption. It is understood that large-grained matter is gravitationally attracted toward the sun, but that fine-grained matter is radiantly repelled from it and that matter of intermediate size many be neither attracted nor repelled. An advancing column of fine-grained electrified matter might bring very little aggregate mass, but would be equivalent to a fairly powerful electric current, and would carry electric and magnetic fluxes with it. These striking the earth might set up appreciable disturbances in the earth's electromagnetic condition. An Atlantic cable is always shielded from external electrostatic influences, and Cape Cod, at midnight, would be shielded by the mass of the earth from solar radiation; but differences of potential might still be set up between midocean and the Atlantic coast by any enveloping system of electric forces.

PRODUCTION, MEASUREMENT AND EFFECT OF VARIABLE WAVE-FORM.

It is well known that measurements made with alternating-current instruments do not all agree in different laboratories or testing-rooms. One and the same transformer, for instance, tested for excitation power loss at normal primary impressed e.m.f. of 1100 volts may give distinctly different readings on the same wattmeter, when measured at the factory and at the purchaser's power house. In such cases, it is usually found that the discrepancy is due to differences in the shape of the e.m.f. wave of the two generators supplying the tests. For this reason, when precision is desired, it is necessary to specify that the measurements shall be made with a wave form substantially sinusoidal. The shape of the wave of an alternating e.m.f. may affect dielectric hysteresis, magnetic hysteresis, eddy current losses, breakdown voltages, power-factors, and instrument corrections. In fact, the wave form affects to some extent nearly every property of an alternating-current circuit. When a high degree of accuracy is aimed at in alternating-current measurements, some investigation of the wave form is usually rendered necessary. There are three important numerical quantities connected with a wave of alternating voltage or current, namely, (1) the maximum, crest magnitude, or amplitude of the wave; (2) the root of the mean square, or effective value as rendered by a properly calibrated voltmeter or ammeter; and (3) the arithmetical mean value, without regard to sign. These three quantities may be briefly designated as the maximum, the effective and the mean values respectivly.

Assuming that we start off in every case with the known effective values, we have to find the maximum and mean values by suitable special apparatus. The ratio of the maximum to the effective value in any wave is called the "amplitude factor" of the wave, which is equal to $\sqrt{2}$ in the case of a pure sine wave. Again, the ratio of the mean to the effective value is called the "mean ordinate factor," which is very nearly equal to 0.9 in the case of a pure sine wave, but may fall below 0.7 in very exceptional cases. The amount of hysteretic loss in a transformer at light load depends directly upon the frequency, and approximately upon the 1.6th power of the maximum cyclic magnetic flux density in the core. Consequently, for constant frequency, it increases as the 1.6th power of the maximum flux density. The eddy-current loss for a given frequency and voltage is independent of the wave form. That is, the ratio of eddy-current loss to the square of the impressed voltage is constant, to a first approximation, with any form of wave. It follows, therefore, that if we maintain constant voltage and frequency impressed on the transformer, we shall incur a fixed eddy-current loss, and a hysteresis loss depending upon the maximum cyclic flux density. But it is easily seen that at constant frequency the mean voltage is directly proportional to the maximum cyclic flux density, so that the hysteresis loss will increase as the 1.6th power of the mean ordinate factor. It is not uncommon to find waves with a mean ordinate factor as high as 0.93. They are usually flat waves in appearance. With such waves the hysteretic loss will be high. On the other hand, it is not rare to find waves with a mean ordinate factor as low as 0.87. They are usually peaked, and if not are always corrugated in appearance. With such waves the hysteretic loss will be low. In fact, the most convenient way to define a peaked wave is by its mean ordinate factor being less than 0.9, while a flat wave is one whose mean ordinate factor is greater than 0.9. A rectangular wave, with its ideal but unattainable limit of flatness, would have a mean ordinate factor of 1.0.

A number of measurements of the hysteretic power losses in laminated iron cores under constant impressed voltage and frequency, but variable wave form, are recorded in an article, by Mr. Lancelot W. Wild, recently published in *The Electrician*, of London, and recently abstracted in the Digest. The wave form of the generator used was varied by connecting in series different windings on the same rotor. The mean ordinate factor of the e.m.f. wave was altered in this way between the limits of 0.87 and 0.915, a variation of 5.2 per cent, capable of increasing the hysteretic loss by nearly 8.5 per cent, according to the preceding reasoning. Three steel samples of different brands are shown to have increased in core loss over this range by 7.8, 7.0 and 8.9 per cent, respectively, when operating at a maximum cyclic flux density of 10 kilogausses. The original paper describes in detail the devices by which the mean ordinate factor and the amplitude factor of a wave may be practically determined without the use of an oscillograph. The mean-ordinate factor is, as we have seen, the key to the amount of hysteretic loss in transformers excited by the wave, within a possible range of, say, 10 per cent. The amplitude factor is important as indicating how high the voltage rises in each cycle. A low mean ordinate factor usually involves a high amplitude factor, so that a wave form that reduces by a few per cent the core loss in transformers involves a higher cyclic stress upon the insulation, besides involving the presence of strong harmonic e.m.fs. along with the fundamental. For these reasons, alternators are usually designed to give wave forms approximating to the sinusoidal, as a little saving in core losses is usually more than offset by higher cyclic voltages and by prejudicial upper harmonics in rotating field motors. Moreover, the sinusoidal form involves a minimum inductance.

Wireless in Congress.

The bill for the control of wireless introduced in Congress by Representative Roberts, of Massachusetts, has been favorably reported by the House Committee on Naval Affairs, and is expected to come up for consideration the present week. This bill provides for a commission, consisting of three representatives from the Treasury, Navy and War Departments, one from each, three representatives of the wireless industry and an authority in the theory and practice of the art. The commission is required to make a study of the entire subject of wireless telegraphy and telephony and to recommend what legislation may be found necessary for operative control.

Among other bills before Congress is one introduced by Representative Peters prescribing penalties for interference with official wireless messages. This bill makes it a punishable offense to originate or transmit a false wireless message purporting to be official, and to use wave lengths between 375 and 425 meters except when communicating with an official wireless station.

A bill introduced by Representative Burke, of Pennsylvania, and referred to the Committee of Merchant Marine and Fisheries, has been urged in opposition to the Roberts bill, the two being in a sense rival measures. It contains stringent provisions against malicious or improper interference, and goes into detail as to wave lengths that may be used. The government stations are required to use wave lengths of either 1000 m or 200 m, and all other stations are forbidden to use for any purpose whatsoever wave lengths between 175 m and 225 m and between 900 m and 1100 m. A wave length of 800 m is prescribed for service between shipboard or shore and shipboard stations. It is further provided that wave lengths used at any station in signaling shall be so generated that successive lengths in the train shall not differ by more than 20 per cent in amplitude. According to the terms of one section, a call shall be made on one wave length and a message transmitted on another. The technical requirements of this bill have been criticised as ill-advised in the present state of the art, and as apt to interfere with the development of wireless.

Another bill before Congress, which may receive favorable consideration, makes compulsory the use of wireless telegraph on all vessels carrying more than a certain minimum number of passengers.

Convention of Missouri Electric, Gas, Street Railway and Water Works Association.

The fourth annual convention of the Missouri Electric, Gas, Street Railway and Water Works Association will be held at Jefferson City, Mo., April 14-16. Electrical subjects largely predominate on the program, which includes the following papers of interest to central-station men: "The Luminous Arc Rectifier System," by Mr. Louis Fredman; "Securing Profitable Day Load," by Mr. J. E. Harsh; "Condensers for Small Central Stations," by Mr. Chas. S. Lewis; "Electrically Driven Water-Works Plants," by Mr. H. W. Clark; "The Primary Law Relating to Public Utilities," by Mr. Geo. McCollum; "Data on Electric Plants," by Prof. H. B. Shaw; "Power Plants in Public Service," by Mr. Edwin S. Harrison.

A visit will be made to the new penitentiary power plant. Among the social features are a smoker on Thursday evening, a banquet on Friday evening and a baseball game on Saturday afternoon between central-station men and supply men. Mr. C. L. Clary, Sikeston, Mo., is secretary of the association.

Joint A.I.E.E. and A.S.M.E. Meeting.

The Industrial Power Committee of the American Institute of Electrical Engineers has arranged to hold a meeting with the American Society of Mechanical Engineers in the Engineering Societies Building, New York, on April 12, at which time a paper entitled "Motor Application to Machine Tools" will be presented by Mr. Charles Fair.

Electrical Trade Conditions in the Far East—I.

By Francis B. Crocker.

A series of contributions in the *Electrical World* during May, June and July, 1899, gave the writer's impressions of Japan, China and the Far East generally from the standpoint of an electrical engineer. The ideas expressed were gathered during a trip around the world extending from October, 1898, to August, 1899. A second globe-trotting tour, beginning Oct. 16, 1909, enables the writer to observe again these countries and their electrical affairs.

These two circumnavigations were made in opposite directions, the first having been westward and the second eastward. This reversal of the order of visiting the various places secures a real advantage because it corrects the human tendency to be over-impressed at first and under-impressed later. Incidentally, it may be noted that the eastward direction of travel is preferable, these countries having generally been approached in that way and always called Oriental from the earliest times, so that they unfold themselves more in accordance with the historical development of our knowledge concerning them. This sequence will be adopted herein.

The writer's two trips also enabled a definite measure of progress to be made by comparing the present electrical situation in the Far East with that found to exist 11 years ago. No attempt was made in the previous articles to cover the subject in an exhaustive manner and to include detailed descriptions or statistics of even the important electrical plants. Attention was principally directed to the characteristic differences between the electrical conditions in these eastern countries when compared with each other and with the United States. Some of the most prominent and typical installations were merely cited as illustrating or gaging the status of each country, the result being a collection of running notes and not a formal series of articles. The same general plan will be followed in the contributions, of which this is the first, but the present notes are more particularly intended to give information as to trade conditions in the Orient and the possibility of increasing the exportation of American-made electrical apparatus and supplies thereto.

Europe, although touched at several points, is not included, but nearly all important countries and cities "East of Suez" were visited, most of them for the second time, and these will be considered. They are Cairo, Bombay, Colombo, Calcutta, Rangoon, Singapore, Batavia, Manila, Hong Kong, Canton, Nagasaki, Kobe, Osaka, Kyoto, Yokohama, Tokyo and Honolulu. The United States consuls, electrical engineers, station managers, selling agents and local dealers were consulted in each place. Almost without exception they were very courteous and gave information freely. Our consular service, now officially designated as "American" and not United States on signs and letterheads, has greatly improved during the last 11 years. Every representative from consul-general to clerk was polite and willing to give information or assistance in getting it. Except when very newly arrived they were well acquainted with local affairs and usually in sympathy with them. That is to say, they were not contemptuous of the people and things that they lived among. There is a tendency for the attitude of the Uitlander to be critical or even antagonistic, which seriously interferes with his ability to accomplish much. The permanency of the consular service and the rigorous examinations for those who enter it have raised its intellectual and also its social plane. Formerly it contained, of course, some excellent men, but now they are the rule and not the exception. Recently out of 78 candidates examined for consular positions only 13 passed, which fact indicates that the standard is high. It may be said that consuls leave their country for their country's good, but this is no longer true in a jocular or uncomplimentary sense.

The only possible conclusion to be reached by anyone who studies the facts is that the United States have an enormous export commerce *Dei Gratia*—by the grace of God. Our unparalleled natural resources, which astonish the whole

world, enable us to produce each year about $600,000,000 worth of cotton, corn and wheat in excess of our own needs and export this surplus to other countries, which not only want, but must have it. These United States also have to spare and to sell abroad yearly about $450,000,000 worth of animal food-products, oil, flour and tobacco. The total value of these seven exports exceeds $1,000,000,000. While some parts of them, such as kerosene, lard and flour, are manufactured, they are merely put in usable form by machinery with little hand labor, being largely the natural result of the blessings showered upon us, and represent no great credit to ourselves. Japan, for example, with more than half as large a population, most of them intelligent and nearly all very industrious, is not able to export more than about one-eighth as much as we do, all goods being included for both countries. Her total area is comparatively small and the fraction available for agriculture much less than in this country, although little patches of ground, less than some 10 ft. long by 1 ft. or 2 ft. broad, are terraced and cultivated on steep hillsides by very hard work. The war is over, but the people still show their heroism in struggling on less glorious fields to pay war taxes which will bear heavily upon them for some time to come.

America's exportation of her bounteous products naturally stimulates and improves her agricultural methods as well as transportation facilities, but these improvements are largely *ingrowing*. The grain and cotton are bought on foreign orders for various European countries and nearly all carried across the Atlantic in foreign ships. We gain practically no experience or skill as exporters; in fact, the very strength of our position in this commerce, which is literally a gift from heaven, as are rain and sunshine, actually spoils us for export trade in general manufactured merchandise, with sharp competition and no natural advantages.

It is a very easy matter to sit at home and graciously accept the orders from foreigners who must have our grain for food and our cotton for clothing. Compare these "cinch" conditions with those under which Germany, by the hardest work, greatest care and patience, has gradually built up an enormous sale of her manufactured goods all over the world. She had no special advantage; on the contrary, Great Britain already occupied the field, and, in fact, literally owned a large part of the earth with her vast empire of colonies and dependencies, very fine harbors, powerful strategic points, far larger merchant marine, as well as navy to protect the whole. Nevertheless, Germany has been able to rise from comparative insignificance in export trade to successful rivalry with England, merely by taking great pains, without any natural advantage.

Two reasons are generally given to explain America's failure to export her full share of manufactures. The first is that she is, or should be, sufficient unto herself, and the second, high wages. The first hardly deserves serious consideration. Most American manufacturers would gladly increase their output, provided only that they could sell the excess abroad. Very often the "export price" is considerably lower than that at which the same goods are sold in the United States. This well-known fact proves that our manufacturers are so anxious to extend their business beyond the limits of home consumption that they are willing to "mark down" their goods and put them on the "bargain counter" in order to induce foreigners to buy.

Certainly it cannot be true that we are or should be satisfied to confine ourselves to domestic trade.

The second reason, high wages, does constitute a serious handicap for the American exporter. When the labor item forms a large part of the total cost, it is practically out of the question for us to compete in markets abroad. To take an extreme case, hand-wrought utensils of silver or brass and ivory carvings can be made in India or Japan far more cheaply than in this country. On the other hand, articles that can be stamped out of sheet-metal by machinery, largely automatic, with very little labor, can be turned out here in lots of many thousands at less cost than in the East because we have a genius for such work, our whole industrial development having been in this direction. The Hindu is born in a certain caste which, in most cases, compels him to toil with his hands most patiently, but also very slowly, with little or no aid from machinery, in just one particular way, like his father and a long line of ancestors before him. He is condemned for life at hand labor as well as at hard labor. The American with equally humble parentage, but privileged to use his head, is quite unlikely to follow closely in his father's footsteps, having the opportunity to change and to rise, as he usually does. Oriental and American methods are diametrically opposite in this and in many other respects, the European being about half-way between.

Although wages are far higher in the United States than in the Far East and very considerably more than in Europe, there is usually a tendency to balance this inequality. A number of employers in different Oriental countries stated that the native workman, who receives a certain fraction of American wages, does only a corresponding amount of work, and that this is true for skilled as well as unskilled labor. These statements are probably somewhat exaggerated, but one experienced engineer actually estimated native labor per man as only one-sixth as effective as at home. That the ratio is so large is hard to believe, but it is very probable that the former does not average more than one-third or one-fourth of the latter. Reasons for this difference are the short and slim physique of the Oriental, laziness in hot climates and lack of familiarity with the work. The fact that three or four times as many laborers are required also calls for more superintendence, which is hard to get in the Far East. These comparisons apply to East Indians, Cingalese, Burmans, Malays, Javanese and Filipinos, but Chinese as well as Japanese are not so different from Americans in effectiveness, because they are usually endowed with much more brains, education and industry than are other Orientals.

Even the workmen in European manufacturing establishments turn out less product per man than those in America. The three reasons given for Oriental inferiority do not apply in this case, although they are generally true, as the writer has observed personally in English, French, German and Swiss machine shops. The explanation is partly found in the fact that we use labor-saving methods and devices, jigs, special tools, automatic machinery, etc., to a much greater extent. It is also customary here for one man to tend a larger number of lathes or other tools. Last, but not least, there is an atmosphere or some influence that makes Americans hustle more than any other people. In fact, ours is the only nation on the face of the globe that really does hustle. Others work hard and work longer, but the word "hustle" does not apply. The Japanese come nearer to it. They are quick mentally as well as physically, but so are the French, and yet they are never called "hustlers." A definition is difficult, if not impossible, but all that is necessary is to compare the pace and expression of the people on Broadway with those on the boulevards of Paris or the Ginza of Tokyo, and the difference is unmistakable. The same marked difference is seen in the factories of the three countries. This is no discredit to France or Japan, as it is very doubtful whether the hustling life is preferable, but the fact remains that we monopolize it. That it is an important factor in our enormous production of raw and manufactured merchandise must be admitted. But it is paradoxical why it has not helped or driven us to greater exportation of manufactured goods. It undoubtedly will in time, but so far it has actually stood in the way of our progress in this direction. We have been so busily engaged in developing our own country and the products we use ourselves that we have not yet had sufficient time or incentive to make a forceful effort to sell our manufactures abroad in quantities even approaching home consumption, with the exceptions already noted.

The Public Service Employee and the Public.

The March meeting of the Commonwealth Edison Branch of the National Electric Light Association, held in the rooms of the Western Society of Engineers, Monadnock Block, Chicago, Thursday, March 24, was addressed by Mr. J. W. Ferguson,

assistant general contract agent of the company, on the subject "The Public Service Employee and the Public," and by Mr. E. W. Grover, of the operating department, who presented a paper on "Substations—Their Equipment and Operation," an abstract of which is found elsewhere.

Among the first duties, said Mr. Ferguson, which the broad-minded, far-seeing men placed in charge of public service affairs have taken upon themselves, has been to instruct by precept and example those under them in the necessity for prompt, honest, courteous and tactful treatment of all with whom they come in contact. Such officers realize in the highest degree that a public franchise is a public trust and recognize the limitations as well as the privileges invested in their franchise rights. They endeavor to show by their acts their realization of the fact that those rights have been granted by the people and that the people have at all times the right to demand of them an account of their stewardship.

This duty the officers realize, said the speaker. Employees who, as their representatives, come daily in more intimate contact with the various elements which make up the body politic, following out this policy, should show that they appreciate the very grave responsibility devolving upon them; that they realize that their duties, well and courteously performed, will disarm criticism, and make friends for the company, while such duties neglected or discourteously performed, will result in a just upheaval that will bring disgrace to them and disaster to the financial interest they are chosen to defend.

On those occasions where the operating department employees come in contact with the public either personally or by telephone, the exercise of great care and tact will always tend to advance the interests of the company and will not take from the self-complacency and satisfaction of the employee himself. The construction man, the inspector and the contract agent come most constantly in direct connection with the public and on them more than any other devolves the necessity of using tact in its most perfect form. The agent, from his very position, should be the perfect embodiment of tact. He should, even under the most exasperating circumstances, maintain the equipoise of the gentleman, always remembering that "A soft answer turneth away wrath." In presenting his contract, he should be sure that the customer thoroughly understands his obligations thereunder, as to the length of the contract and the penalty agreed upon in case of its non-fulfillment, and the rental feature where such exists, etc.

The inspector should avoid the use of technical or semi-technical terms in explaining to the customer the obstacles in the way of his receiving service. The construction man, too, by suavity of manner and care as to answering questions which may involve conditions with which he is not familiar, and by the promptness and neatness with which he does his work, can improve the "entente cordiale," and often has produced written encomiums which tend to the benefit of the company, his department and himself.

Tests of Telephone Service by Wisconsin Commission.

Results of an investigation of telephone service by the engineering staff of the Railroad Commission of Wisconsin are given in the annual report of the commission for the year ended June 30, 1909. The investigation was confined to 25 exchanges in the 18 largest cities of the State.

The service at each exchange was tested secretly in order that the results might represent the actual existing conditions. A total of 112 calls was made on each exchange and the time of response of both central and subscriber was noted. Twelve of the above calls were made from toll stations. The number of wrong-number calls and the number of "busy" and "don't answer" reports were noted as well as the time required to report them. It was found that the character of service afforded by the different exchanges varied through wide limits. From an average of all the calls made, it was found that the total average response of 24 exchanges was 4.78 seconds; the quickest average response was 3.17 seconds and the slowest 7.3 seconds. The average of the 12 fastest exchanges was 4 seconds. In the fastest exchange 60 per cent of the calls were answered in 3 seconds; in the slowest, 12 per cent; the average of the 24 exchanges was 27 per cent.

From a study of all the data taken during the test, supplemented by the inspector's opinion of the service afforded by each exchange, it was noted that in general the best all round service was given at those exchanges whose operators were very prompt in answering calls. Therefore, the "promptness of operators in answering calls" seemed to be the most important point in telephone service, transmission, equipment, etc., being equal. It is also a feature which may be readily tested and standardized.

These tests are to be repeated from time to time, and every effort made to improve the quality of service rendered by the poorer exchanges. The inspectors, on their frequent trips through their districts, make it a point to check the telephone service at each exchange as often as possible. As an example of the improvement that can be made, in May, 1909, the result of 112 calls made on an exchange in a city of 30,000 inhabitants showed that the average speed of service was 6 seconds. This fact was called to the attention of the company, with the result that, when the second test was made in November, the average time of answer had been reduced to 4 seconds and the service otherwise generally improved.

Maryland Public Utility Legislation.

The Maryland Legislature has passed a measure opening to general competition electrical supply service in Baltimore, which by previous legislation has been practically restricted to one company. A bill now attracting much attention is one authorizing the Baltimore City Council to negotiate for natural gas with the Consolidated Gas, Electric Light & Power Company, and providing that in the event an agreement can be reached, a contract may be closed without waiting two years for the Legislature to ratify it. Another bill also creating a lively interest provides that no electric light or power company shall be permitted to enter the Baltimore field unless it has a paid-up capital stock of not less than $1,000,000. The latter bill is being opposed in the interest of owners of isolated plants in Baltimore, as it will prevent them from selling surplus electrical energy.

State Senator Gorman has made some changes in the Marbury public utility bill, recently introduced in the Legislature, whereby the number of commissioners is reduced from five to three, and $5,000 is added to the working fund of the commission. The commission is also empowered to examine into the management and conduct of public-service corporations, may take such testimony as may be deemed advisable, require the attendance of witnesses and the production of books and papers, and order examinations by expert accountants. The commission is to recommend to the Governor and Legislature such change in rates, tolls and fares as may be thought necessary, and to prepare bills to carry out these recommendations, which are to be submitted to the Legislature. It is said that the Marbury bill is opposed by the Governor, who has expressed himself in favor of a commission which has actual power, and not merely authority to investigate and recommend. The Marbury bill appears to be largely based upon the public utility bill which was recently passed by the New Jersey Legislature.

Proposed Ohio Public Utility Commission.

A substitute for the Woods public-utilities bill has been introduced in the Ohio House of Representatives in which many of the objections to the original bill have been removed. The Railroad Commission, which now has authority over steam and interurban roads only, is to constitute the utilities commission of Ohio and its authority is extended to all public utilities, with greatly increased powers. The salaries of the members of the commission are fixed at $6,500 a year each and the term six years. One is to have a general understanding of railroad matters and another of public-service corporations. The ap-

proval of the commission must be had for the increase of stocks and bonds. Companies cannot increase the aggregate capital stock because of consolidation, but a consolidated corporation, desiring to increase its plant or extend its service, may increase its capital stock or bond issues with the approval of the commission. The commission will have no power to value properties, but may inspect the books in order to determine whether charges are fair or not. In this way it may gain some ideas of valuations. The commission may fix rates on petition of 25 citizens of a municipality to the effect that they are not securing fair treatment in that respect.

New Jersey Public Utility Bill.

A public-utility bill introduced by Senator Wakelee has passed through the New Jersey Legislature and received the signature of Governor Fort. The bill provides that the present Board of Railroad Commissioners shall become a Board of Public Utility Commissioners, with jurisdiction over all public utilities, which term is defined to include every electric light, heat and power, street railway, telephone, telegraph, railroad, express, canal, subway, gas, water, pipe line, sewer, or other corporation, association or joint stock company operating within the State of New Jersey for public use under privileges granted by the State or by any municipality.

Supervision is given to the commission over all public utilities as above defined, with power, after hearing upon notice, to require every public utilitiy to comply with the laws of the State and to perform the public duties imposed upon it thereby; to furnish safe and adequate service; to keep its books, records and accounts so as to afford an intelligent understanding of the conduct of its business; to require every public utility of the same class to adopt a uniform system of accounting; to direct a public utility granting rebates or other unjust, unfair and unreasonable discrimination to cease the practice immediately. It has power to investigate any accident happening in connection with the operation of any public utility, and to order and examine complaints concerning the rates charged and to make such recommendations as it may see fit concerning accidents and rates. It has power to compel the attendance of witnesses and the production of papers, accounts and documents; to swear witnesses and to issue subpoenas.

The bill provides that no issuance, sale and delivery of stock or securities maturing in more than 12 months hereafter made by any public utility shall be valid until approved by the board; and the board is required to approve of such stock or securities upon being satisfied that their issue is in accordance with the provisions of the law relating thereto. No lease of its property, rights and franchises by a public utility, and no merger or consolidation of its property, rights and franchise with the property, rights and franchises of any other public utility, shall be valid until approved by the board.

The right to appeal from the orders of the commission is conferred upon every public utility. No privilege or franchise hereafter granted by any local, municipal or county governing body shall be valid until approved by the board, which shall, after due hearing, determine that such privilege or franchise is necessary and proper for public convenience. Any public utility may appeal to the board from any order or regulation made under existing laws by any local, municipal or county governing body, and the board is given jurisdiction to hear such appeal and determine the matter on its merits and make such order in the premises as may seem just and reasonable. Public utilities are prohibited from granting or bestowing upon any local, municipal or county official any discrimination, gratuity or free service whatsoever, which prohibition, however, shall not prevent the transportation of uniformed public officers while engaged in the performance of public duties.

The compensation of the members of the board is fixed at $6,000 per annum, and that of the secretary at $4,000 per annum; but it is provided that the total expenses of the board, including salaries, shall not exceed $50,000 per annum. No employee of the board is permitted to have any official relation with or hold stock in any public utility operating within the State of New Jersey; and no member shall sit or take part in any proceedings concerning or with regard to any public utility in which he holds any stock, bonds or other securities, nor hold any office under the government of the United States or any other salaried office under the government of New Jersey.

Approval of Canadian Waterways Treaty.

According to reports from Ottawa, Canada has decided to approve the waterways treaty, with the United States Senate "rider," providing that existing rights of riparian owners on the St. Mary's River at the "Soo" in either country shall not be interfered with. Canada had declined to accept this rider, and the treaty was not adopted. To meet Canada's objections, the United States bought all of the land on the American side of the St. Mary's River, and has satisfied Canada that her rights will be safeguarded.

The following items are covered in the treaty:

Control of international water for power, irrigation and navigation purposes. The treaty establishes a satisfactory arrangement for the safeguarding of the navigation interests of both countries on the Great Lakes and other international waters.

Conservation of water-powers, especially at Niagara Falls, and maintenance of an adequate flow of water in all channels along the whole line of boundary waters.

Conservation of scenic beauty of Niagara.

Securing of the right of the vessels of both countries to the free use of all canals.

Provisions for the adjudication of all future differences between the two countries with respect to the boundary waters by means of a miniature Hague tribunal, consisting of a permanent commission of six members, composed of three American and three Canadian representatives.

The most important clause of the treaty deals with the division of control over power at Niagara Falls and the restriction of the amount of water diverted so as to preserve the scenic beauty of the falls. The whole natural flow below the crest of the rapids is approximately 200,000 cu. ft. per second. Without the treaty it would be possible for either or both countries to divert for power purposes substantially the whole of the natural flow.

The international waterways commission concluded that not more than one-quarter of the whole flow could be diverted without serious injury to the scenic effect. The existing power plants are capable of using about 54,500 cu. ft. per second. The treaty prohibits any diversion for power purposes, exceeding 56,000 cu. ft. per second, 20,000 ft. on the United States side and 36,000 cu. ft. on the Canadian side.

The first article of the treaty provides that the boundary waters, including Lake Michigan, shall be free for the purposes of commerce to both countries.

Article 2 deals with the waters which in their natural channels flow across the boundary or in boundary waters. Each country reserves the exclusive control over the use and diversion of such waters on its own side of the boundary. The right is reserved by each country to object to any diversion which will materially injure navigation interests.

Article 3 prohibits any new uses, obstructions, or diversions of the boundary waters which would affect the natural level or flow of such waters on the other side of the line except with the approval of the joint commission. This clause particularly affects the Chicago drainage canal and the Erie canal projects. Without such a stipulation there is nothing to prevent the United States from diverting into the Erie canal and using for power purposes practically the whole of the Niagara River.

Article 4 prohibits either country without the approval of the commission to construct dams which would raise the natural level of the water on either side of the boundary.

Article 8 provides that any surplus waters shall be equally divided for power or for navigation, each country voluntarily

limiting itself to one-half of the whole amount. To regulate the carrying out of this the joint commission is established. Practically any matter of difference between Canada and the United States may be referred to the joint commission.

The rider inserted by the United States Senate affects only a short stretch of water on St. Mary's River at Sault Ste. Marie. Its object was to protect and preserve the existing rights of the land owners in Michigan at Sault Rapids. It does not give any new rights or enlarge the existing rights and is applied equally to both sides of the river. The American Secretary of War, by the acquisition of all lands north of the present ship canal at the Sault has eliminated any danger to the Canadian interests through any larger diversion of waters.

Canadian Opposition to St. Lawrence Hydroelectric Development.

Chairman Sifton, of the Canadian Conservation Commission, has spoken quite freely concerning the causes for opposing the proposed hydroelectric developments along the St. Lawrence River at the Cornwall Canal. The committee has reported that the St. Lawrence Power Transmission Company is the same as the St. Lawrence Power Company, which has been incorporated in the State of New York with power to build a dam across the St. Lawrence for the development of electrical energy, and that the transmission scheme is really a move to get a foothold in eastern Ontario and to fight the hydroelectric plans in the province.

During the present session of the Legislature there was introduced a private bill to enable the St. Lawrence Power Transmission Company to erect wires for the distribution of energy on the Canadian side of the St. Lawrence. When the proposed legislation came to be examined by the private bills committee it was found to be pretty drastic. The company was authorized by it to get energy from anywhere and to build lines anywhere. It was to be free to expropriate the property of the Crown in Ontario in order to serve its ends, and it was to have the right to build in any municipality without asking the permission of the people. A private corporation owned in the United States, it was to have authority to take the property of Ontario for its own purposes, without consulting the Government of the province.

According to the opposition forces, the bill to incorporate a transmission company, and to relieve the people of eastern Ontario of the terrors of a power monopoly under the Hydro-Electric Commission was simply a part of a scheme to enable a United States company to acquire control of the greatest of the St. Lawrence water-powers and to prevent the development of these natural resources by the people of Ontario. The company had already secured rights from the State of New York. It had received a charter, including authority to build a dam across the St. Lawrence in Canada. All it needed to complete its scheme was the incorporation of the transmission company and the grant to that company of the right to expropriate Ontario property, such as the bed of the St. Lawrence and the shore of the river, and of power to operate in the various municipalities regardless of the views of the people there.

It is claimed that the opposition of Mr. Sifton is a blow to the development scheme in making it difficult to push the bill through the Legislature.

Separate Bell Companies for Ohio, Indiana and Illinois.

The present properties of the Central Union Telephone Company in the States of Ohio and Indiana will shortly be taken over by separate operating companies being organized for this purpose, leaving the present Illinois district to the Central Union Company. At the present time the Chicago Telephone Company is operating in ten counties of Illinois, the rest of the territory being given over to the Central Union Company. Combination of these two Bell interests in Illinois will come later, probably within the next two or three years, although the recent report that such an action, which has been discussed for a long time, was about to be taken, is denied by the officials of the companies, who declare the rumor has no present foundation. The division of the territory of the Central Union Company has been planned as a measure to capitalize the company's floating indebtedness, by which it is hoped to put its stock on a dividend-paying basis within the near future.

Ohio Independent Telephone Situation.

At a meeting of the directors of the Ohio Independent Telephone Association, held in Columbus last Thursday, Mr. Frank L. Beam was re-elected president. Mr. Beam has held the office of president and manager of the organization for a number of years and through his work the independent movement has continued to gain rapid headway. His influence has extended beyond State boundaries, and he is known wherever independent companies exist. Mr. H. P. Folson, of Circleville, was chosen as secretary and Mr. Ralph R. Reamer, of Columbus, treasurer. The executive board, to which all matters of importance are referred, consists of the following members: Messrs. S. E. Ward, Mansfield; W. D. Rush, Greenville; H. P. Folsom, Circleville; J. D. Cable, Lima, and C. Y. McVey, Cleveland.

A special committee, appointed at the annual meeting of the association recently, is now engaged in investigating the toll rates of the Bell lines in Ohio, and as soon as this is completed the rates used by the United States Telephone Company will also receive attention.

Although the intentions of J. P. Morgan & Company were seriously questioned by several members of the association at the annual convention, it is said that the assurances given by Mr. Frank A. Davis, president of the United States Telephone Company, resulted in establishing faith in what has been said as to the course that is to be pursued in the future. This settled the election of officers for the ensuing year, and it is believed that everything will go along smoothly hereafter.

President Frank A. Davis, of the United States Telephone Company, has stated that new rates to be made for that company will be established without reference to those of any other company, but with a view to giving the best service at a minimum cost to the local companies of the State. Data gathered by a special committee of the association, referred to above, will be used by Mr. Davis in making up the rates, the figures furnishing a basis as to what the service actually costs between various points or between points of like distances and conditions.

The Portage County Telephone Company has purchased the Central Union exchange at Ravenna and local lines adjacent and will hereafter operate them in connection with its own exchange. The business rates will be increased to those used by the Central Union, but there will be no change in residence and toll-line rates. Either of the systems may be used for long-distance business, as both now have lines running into the exchanges.

It is stated that negotiations are under way for about the same kind of a merger at Bowling Green. Mr. G. H. Gentry, special agent of the Central Union, has been there for some time talking with the business men and others relative to their attitude on the matter. The plan, according to reports, is to turn over the Central Union exchange to the Home Telephone Company, which now operates most of the telephones in Wood County, and that the system shall then be connected up with both the Bell and independent lines for long-distance service.

The Elson telephone bill, passed by the Ohio House of Representatives some time ago, was given a hearing before the committee on railroads and telegraphs of the Senate last Wednesday evening. The principal arguments for the bill were to the effect that it would make it possible to do away with the multitude of small systems now in operation; that it would

mean better service with payment for the one service; that it would prove a better investment for those who put their money into the business, whether independent or Bell; and that competition is taking away the profits wherever there are two companies operating. While a number of representatives of the Bell companies, among them Mr. H. M. Hill, of Indianapolis, spoke for the bill, several business men also put in a word for it principally on the investment feature and the expense and annoyance of two services.

Judge Lewis Brucker, of Mansfield, was one of the principal speakers against the bill. In its present form, he said, it is a monstrosity, as the railroad commission can have little to do with regulation under it. He said he was not opposed to merging local systems, but that the Elson bill should be combined with the Woods utilities bill to make it effective, as it should be. He stated that there should be no possibility of the long-distance companies merging, as that would place all companies at the mercy of a monopoly which could make or break them, as the officers see fit. Messrs. John A. Ainsworth, of Dayton; H. P. Folsom, of Circleville, and Harry Critchfield, of Mount Vernon, were among those who spoke against the bill as it now stands.

The Electric Furnace Plants of the U. S. Steel Corporation.

As previously reported in these columns, the first electric furnace plants erected by the U. S. Steel Corporation are a 15-ton Heroult furnace at the South Chicago works of the Illinois Steel Company and another Heroult furnace of the same size at the Worcester, Mass., plant of the American Steel and Wire Company. At South Chicago the Heroult electric furnace is used to refine molten metal obtained from the ordinary acid-lined Bessemer converter. The electric process, therefore, includes both desulphurization and dephosphorization. The Heroult furnace has been in continuous operation at South Chicago since May, 1909, and has demonstrated that it is now a commercial metallurgical apparatus no longer in the experimental stage. The average of heats made per day is 12. The furnace is in continuous operation except on Sundays, the operation being discontinued on Sunday because the converter plant does not work on that day.

The specific energy consumption depends, of course, on the impurities in the charge and the desired composition of the refined steel. When both desulphurization and dephosphorization are required, the electrical energy required per net metric ton is about 190 kw-hours, but when the charge supplied to the furnace is low in phosphorus, this has been reduced in commercial operation to about 100 kw-hours per net metric ton. The time of the heat varies approximately between one hour and one hour and a half, counting only the time while the electric current is on. During a whole day the intervals between the successive heats—that is the time when no electrical energy is consumed—may amount to about one-third of the whole time.

The electrical energy is generated by means of gas engines operated with blast-furnace gas, the two plants of the Steel Corporation at South Chicago, Ill., and Gary, Ind., being electrically connected in parallel. The charge for energy supply made to the electric furnace plant is ½ cent per kw-hour actually consumed, as taken from the meters. At South Chicago it is a disadvantage that no space was available for the electric furnace plant in the immediate neighborhood of the Bessemer plant so that the molten Bessemer metal has to be brought to the electric furnace over a distance of one-quarter of a mile.

The cost of repairs of the Héroult furnace is said to be very low. A silica roof is stated to last for 129 heats, while the repairing of the bottom is done by shoveling in some dolomite in the intervals between successive heats. The total cost of repairs is given as approximately six cents per ton.

The consumption of electrodes averages six pounds per ton of steel and this figure is stated to be true both for graphite and amorphous carbon. The electrodes, as used at present, are made of Acheson graphite rods, 48 inches long and 8 inches in diameter. Three such rods are butt-connected to a total length of 144 inches, and three such 144-inch rods are arranged side by side to form a single electrode consisting of a solid bundle of three rods with the cross section a true shamrock.

The electric steel produced in South Chicago is used for rails, axles, etc. At Worcester, Mass., the Heroult furnace is used to refine molten steel obtained from the basic open-hearth, and since the metal obtained from the open-hearth is already largely dephosphorized, the time of the heats is shorter and the specific energy consumption in the average is less than at South Chicago, but no exact figures from commercial practice are yet available. The electric steel produced at Worcester is used especially for fine wire, such as piano wire. This furnace has been in operation since January, 1910.

Tungsten Lamp Patent Litigation in England.

On March 9, Justice Parker, of the High Court of Justice, Chancery Division, of Great Britain, handed down an opinion sustaining a claim of infringement made by the "Z" Electric Lamp Manufacturing Company against another manufacturer of tungsten lamps. The patent in suit is one under which a lamp known as the "Z" or "Szed" tungsten lamp is manufactured by companies which have been organized in Great Britain, France, Belgium, Italy, Austria, Spain and Russia. The lamp is claimed to be a very successful form of tungsten lamp, as indicated by a number of disinterested tests, and is stated to have a large sale throughout Europe.

The patent in suit relates to a means for obtaining metallic filaments as free from carbon as possible, it being stated that even a small amount of carbon contained in the filaments interferes very prejudicially with their strength and serviceableness, and also causes blackening of the bulb. The invention provides means capable of being carried out on a manufacturing schedule, whereby the last traces of carbon in a filament can, it is claimed, be removed in such a way that the metal does not suffer. This is accomplished by the decarbonizing in vacuo the filaments by means of gases produced by heating phosphorus compounds containing hydrogen and nitrogen, such as phospham or phosphoramide. Phospham is said to be especially suited for the purpose, because not only is the nitrogen contained therein released in vacuo from its combination even at a comparatively low temperature, but when set free forms with the carbon, cyanogen or cyanogen compound, and at the same time is capable of fixing the oxygen still present or exerting a reducing action upon metallic oxide should such be in the filament. Some red phosphorus may also be added, especially in cases where oxide may be present in the filament in any appreciable quantity.

The court said that it appears from this that the function of the nitrogen is to remove the carbon, and the function of the phospham is to remove any ogygen and reduce any metallic oxide. In carrying out the process a little phospham is added to the metallic powder, the mixture is ground thoroughly and a paste prepared in the usual way. The filaments are then in the ordinary course squirted and raised to incandescence by heat in vacuo. The action of the phospham then takes place, and it is claimed that the filaments become absolutely free from carbon without their strength being injuriously affected. The phospham may, however, instead of being mixed in a paste, be placed with the squirted filament in the baking oven, so that the gases therefrom may act externally on the filament during the baking process, which is conducted in vacuo. In other modifications cited the phospham acts on the filaments in the glass bulb in which the baked filaments are flashed or in the globe of the lamp itself.

The validity of the patent was contested on three grounds, namely, that the specification is misleading, that it is insufficient, and that the invention is not useful. The court considered at length these charges, and decided that none of them was well taken. In conclusion it was decided that the process in question

less frequently for peak purposes, being reserved for stand-by or emergency service. This change in practice is apparent from the following figures: In 1898 there was one battery in service and during that year there was a total of 246 discharges. In 1900 there were three batteries with an average of 125 discharges each, and in 1909 there were fifteen batteries with 95 discharges each, and in 1909 there were 20 batteries with an average of 11 discharges each. As the present total capacity in rotary converters is about 50,000 kw the system could have been maintained during the peak load of last year for about 20 minutes in case the high-tension supply had been interrupted.

With the Commonwealth Edison Company it is standard practice to start all rotary converters from the direct-current end as motors through resistance boxes, closing the oil switches when synchronism is attained. Means are also provided in some of the stations for starting converters from the alternating-current side by connecting to one-half potential taps from the transformer secondary. With no direct current available for starting the rotaries inverted, it would be practically impossible to start and connect individual machines. If such a contingency ever occurs, it is planned in the method which has been developed to connect all the rotaries directly through to the generators, steam then being gradually admitted to the turbines, and the entire system thus started up from standstill, rising in voltage and frequency until normal conditions are restored. Experiments that have been made with this method in picking up very large loads lead the engineers of the company to believe that even the entire system might be so started from the standstill.

The largest substation distributing 60-cycle energy is known as the Lake View substation, in which there are installed 5500 kw of frequency-changers. At Hyde Park there is 5000 kw installed, consisting of two vertical-shaft, 2000-kw units and one horizontal-shaft, 1000-kw unit.

In the discussion which followed Mr. Grover's paper, Mr. Ernest F. Smith, superintendent of substations, reviewed some in the interesting considerations involved in restoring service to the system, should the direct-current network ever become completely deenergized. Mr. B. G. Jamieson, assistant to the electrical engineer, and in charge of station design, discussed the shock-absorbing characteristics of reactance inserted in the railway supply circuits, and mentioned briefly the prospective use of split-pole converters.

School-Room Lighting.

At a meeting of the Chicago Section of the Illuminating Engineering Society following luncheon Thursday noon, March 24, Mr. A. J. Marshall, of New York City, and secretary of the New York Section of the Society, presented an account of some tests on public school-room lighting, conducted with Mr. George W. Knight, supervising engineer for the Board of Education of Newark, N. J. These tests, which were made at the Burnett Street Public School of that city to determine the most desirable lighting system for its class rooms, comprised examinations into the efficiencies of eleven kinds and arrangements of illuminants, and were undertaken to determine the average intensity of illumination over the desk area, and the maximum variation from this average.

The rooms used were of the typical class-room type, 32 ft. long, 24 ft. wide and 12 ft. high, with the usual internal finish of blackboards, white plaster, light-oak woodwork, etc. For the preliminary tests with the six existing ceiling outlets, illuminometer readings were made, using 22 16-cp carbon filament lamps, five 75-cp graphitized-filament lamps, and five 100-watt frosted-tip tungsten lamps with glass reflectors. The illumination obtained from the last-mentioned system proved 42 per cent higher than from the next best scheme employing the graphitized-filament lamps.

Later, a second series of eight tests was conducted, using one of the two rooms previously tested. For convenience in disposing the lamps, while experimenting to discover the arrangement which would prove most effective, parallel wires were stretched across the room close to the ceiling, and upon these wooden rods were arranged to slide, carrying lamps connected to the ceiling outlets by flexible cords. The lamps could also be raised or lowered to any desirable height by paying out the cord. Various combinations and arrangements of 9-light, 6-light and 5-light schemes, utilizing both graphitized and tungsten-filament lamps were examined with respect to the illumination, as read by illuminometer readings, at the center of each of the 48 desks in the room. Several of the arrangements tested involved the feature of offsetting the lamps in such a way that their light would generally fall from the left and rear of the pupils. After the completion of the test the scheme which had been designated as No. 5, utilizing six bowl-frosted tungsten lamps with glass reflectors, arranged symmetrically, the bottom of each lamp coming to a point 9 ft. 7.5 in. above the floor, or 7 ft. above the plane of the readings, was adopted as standard in the public schools of Newark, with the exception that 100-watt tungsten lamps were used instead of the 60-watt lamps originally experimented with. This arrangement gives a mean intensity of illumination of 3.65 ft.-candles. The cost of operation for each room is now about six cents per hour—about half that with the low-hung carbon-filament lamps—besides resulting in a material increase in effective illumination and the removal of all sources of glare from the field of vision.

In comparing the results of these tests with those arrived at by the Boston school-room investigators, Mr. Marshall said that the latter's intensity figure of approximately 2 ft.-candles had proved insufficient at Newark, where the 60-watt tungsten lamps experimented with were changed to 100-watt lamps in order to increase the intensity from 2.61 to 3.65 ft.-candles. The speaker also referred to two new systems of class-room lighting which have been suggested but which have so far been subjected to little investigation. The first utilizes a box-like arrangement extending the length of the room along the corner of the side walls and ceiling. All sides of the box are opaque, except the bottom containing prismatic glass by means of which the light from the tungsten lamps within is projected at the proper angle into the room. A second scheme employs a line of lamps along the ceiling, close to the side wall, arranged much after the fashion of window lighting.

In closing his general remarks on the subject of public-school lighting, Mr. Marshall observed that although the illuminating engineer may do much in the school room itself to alleviate the conditions of improper lighting, it must me remembered that most of the child's study hours are spent in the often imperfect illumination afforded by the home, and in this direction there remains much valuable missionary and educational work to be done before the entire results of scientific school lighting will be achieved.

Illumination and the Eye.

Dr. Henry Gradle, a physician and oculist of Chicago, was the guest of the Electric Club of Chicago at its regular Wednesday luncheon, March 23, and spoke on the subject "Illumination and the Eye." Dr. Gradle confined his remarks to a discussion of the physiological characteristics of the eye itself, pointing out a number of its peculiarities which are of interest as well as of importance to those who have to do with the designing of artificial illumination. After sketching briefly the structure of the eye—contrasting it with the photographic camera, with which, indeed, he said, it compares unfavorably in the adaptation of some of its parts—the speaker referred to the interesting function by which color sensation is sometimes quite separate from mere light sensation, the former often being entirely absent at low intensities. After all, he remarked, we recognize qualities of color and shade largely as the result of contributing incidents. Thus a shadow on the carpet is recognized as such, and not mistaken for a spot, rather as a result of the general circumstantial evidence that it is a shadow than from any intrinsic difference in its surface appearance from that presented by a spot of the same shade.

normally operates to remove carbon from a filament, and since it is admitted that the defendants used the process on a filment containing carbon, they infringed the patent.

Temperature Coefficients of Electrical Resistance.

At the recent meeting in Boston, Prof. A. A. Somerville, of Cornell University, presented a paper on the subject of the temperature resistances of nickel, nichrome, tungsten and molybdenum. The variation in temperature considered was from 0° C. to about 1100° C. The resistance thermometer was used to measure temperature, and Callendar's platinum temperature resistance curve was taken as a standard.

The thermometer was calibrated at the temperatures of melting ice, boiling water and melting copper, in air and in nitrogen, the temperatures being probably correct to within half a degree. It was connected to a Callendar automatic temperature recorder and the temperature for a furnace run of several hours was thereby recorded.

The heating device consisted of an electrical resistance furnace wound with either nickel or nichrome. The core of the furnace was a porcelain tube 50 cm. long and 3 cm. in diameter.

Nickel and nichrome when wound in the form of resistance thermometers show unusual resistance temperature curves. Nickel changed from 1 to 4 ohms in changing from 0° C. to 350° C., when the coefficient became much smaller and at 1100° C. was only 5.5 ohms, as compared to 1 ohm at 0° C. The curve for nichrome is similar in shape, but the actual coefficient is only one-nineteenth as large as that of nickel.

Tungsten and molybdenum both show large coefficients. Starting with 1 ohm at 0° C., the former measures 7 ohms at 1000° C. and the latter 5.7 ohms at the same temperature. They are nearly straight line curves. Both these materials oxidize readily, and must be heated in an atmosphere of nitrogen or some gas to exclude oxygen.

Relations of New York Public Service Commission with Public Utility Corporations.

In its annual report, the New York Public Service Commission, Second District, contains the following statements regarding the relations of the division of statistics and accounts with electrical corporations:

"The reports rendered by most of the electrical corporations and gas corporations were much less satisfactory than those made by the railroad corporations and street-railroad corporations, although it should be stated that some of the larger of the lighting corporations made good reports. Uniformity of accounting is much less an accomplished matter among electrical corporations and gas corporations than it is among railroad corporations and street-railroad corporations; and inasmuch as the accounting orders of this commission for electrical corporations and gas corporations did not become effective until Jan. 1, 1909, the reports for the latter half of 1907 and for the year 1908 were necessarily compiled from records that had not been constructed under the prescribed uniform systems of accounts. We expect to find that the reports for the year 1909, being based on the uniform systems of accounts prescribed by this commission, are much more consistent than those rendered for preceding years, and will require correspondingly less correction. The corporations have, in the main, entered heartily into the spirit of these accounting orders. Numerous practical questions in connection with the interpretation of these orders have been submitted to this division and tentative decisions have been given thereon. After such decisions have been subjected to the criticism of the various persons interested in questions of this character they will be laid before the commission for its action.

"In this connection it is proper to mention the valuable aid rendered by the accounting committee of the Empire State Gas & Electric Association. This association, which comprises many of the lighting corporations of the State, has a committee for the purpose of considering questions arising in connection with accounting practice. Shortly after the adoption of the accounting orders of this commission effective Jan. 1, 1909, many of the smaller lighting corporations began to make inquiries concerning the readiest means of procuring suitable stationery and other material aids in systematic accounting. Inasmuch as the accounting committee of this association was composed of practical accounting officers of various corporations ranging from large to small, and inasmuch as it seemed inadvisable for this commission to promulgate at the present time any orders fixing the forms of stationery and other matters of practical detail, the question of bookkeeping forms was referred to this committee. The committee gave much attention to the matter. Several conferences were had between the members of the committee and representatives of the commission, and at the annual meeting of the association, Nov. 17, 1909, the committee made a very carefully worked-out report and recommended a very satisfactory set of accounting forms. It also gave a simple yet thorough discussion of the principles of bookkeeping as applied in the accounting of electrical corporations and gas corporations. It is thought that this report will be of material assistance to the smaller corporations whose revenues are not sufficiently large to enable them to employ skilled accountants."

Chicago Substation Operation and Equipment.

At the March meeting of the Chicago Commonwealth Edison N. E. L. A. Branch, Mr. E. W. Grover, of the Commonwealth operating department, presented a paper entitled "The Substations of the Commonwealth Edison Company—Their Equipment and Operation," in which he discussed in general the operating practice of the generating and distribution systems. At the present time the Commonwealth Edison Company is operating 33 substations in addition to supplying energy to numerous railway substations. Of this number 22 distribute 250-volt direct current, five 4000-volt, 60-cycle alternating current, two, both 250-volt direct current and 4000-volt, 60-cycle alternating current, three 4000-volt, 60-cycle and 600-volt direct current, and one 250-volt and 600-volt direct current. The total capacity in 150-volt rotary converters in service at present is about 53,400 kw; in 25 to 60-cycle frequency changers, 24,850 kw, and in battery capacity at the one-hour rate, approximately 20,000 kw. To operate the above 33 substations, there are required, exclusive of the supervising and repair forces, approximately 100 certified operators and 35 battery men and apprentice operators. The direct-current substations feeding the Edison network vary in capacity from 750 kw to 6000 kw, exclusive of batteries. The largest one supplying the low-tension, direct-current service is the Market Street substation, which contains four 1000-kw units, one 2000-kw unit and two batteries with a total one-hour capacity of 2700 kw. In this substation, which may be considered typical, each of the converting units is supplied by three-phase, 9000-volt, 25-cycle alternating current.

In many of the direct-current substations in addition to the rotary-converter units, one or more storage batteries have been installed. There are at present 22 of these batteries installed in fifteen substations, varying in one-hour capacity from 390 kw to 1415 kw each. The first battery on the Edison system was installed in 1899 and consisted of 166 cells with a capacity of 5200 amp for one hour at 250 volts pressure. This was at that time the largest battery ever installed for lighting service, and up to the present has not been exceeded in ampere capacity by any other one battery. Since that time two other batteries when synchronism is attained. Means are also provided in makes it the largest lighting service battery installation in the world.

Originally the batteries were used to relieve the peak load on the generating stations, but as the system has enlarged and the generating capacity increased the batteries are operated

Progress reports were made from a number of other committees, and Secretary C. C. Rosenberg, of Bethlehem, Pa., then read a paper by Mr. Otto Holstein, chief train dispatcher of the Central Railroad of Peru, on "Lightning Protection." Mr. Holstein first referred to the severe electrical storms in Peru and then described the various types of arresters in use. On the Central Railroad of Peru he found a type of lightning arrester that was entirely new to him. The performance of this piece of apparatus was quite satisfactory. The device is made of cast iron and for the two-line type is quite heavy, weighing about 15 lb. The ground plate measures 7.75 in. x 6.31 in. It stands on four legs cast with a plate. The whole upper surface of this plate is furrowed and sharply ridged. The line plates are likewise furrowed. When assembled the arrester has these sharp ridges at right angles, making every point of intersection (of which there are thousands) a spark-gap with an air space of 1/32 in. to break down. There are thousands of these small spark-gaps in multiple with but 1/32 in. of air resistance to break down, and this imposes but a negligible resistance to a static discharge of any intensity.

A paper on "Soda-Copper Oxide Primary Cell on Track Circuits" was then presented by Mr. E. L. Marshall, of the National Carbon Company. The paper gave a comparison of the soda-copper oxide cell with the gravity cells. There have been three types of soda-copper oxide cells. One of these, which has a visible indicator to show when the cell needs renewing, was described at some length by Mr. Marshall. This cell is spoken of as non-freezing and non-congealing. There was considerable discussion, centering particularly around the question of leakage of electricity in signaling operations with primary batteries.

At the afternoon session Mr. H. M. Beck, of Chicago (Electric Storage Battery Company), read a paper on "The Portable Storage Battery in Automatic Block-Signal Service." He described the use of portable storage batteries in signaling work. Referring to methods for charging, he said that it is practicable to locate the charging plant at some place where reliable electrical energy can be purchased rather than to attempt to install a generating outfit, as electricity can usually be purchased for less than it can be made. Small charging plants are apt to be unreliable and require a large percentage of the battery man's time to keep them running. It is also of considerable advantage to be able to charge at night, which is hardly practicable with small generating plants. Electric service companies usually give a favorable rate on electricity for charging storage batteries on account of the character of the load. Electricity for this purpose can be usually purchased at from 3 cents to 8 cents per kw-hour. Where it is necessary to install a charging plant a 2-kw or a 3-kw equipment will usually be required. There are now a number of railroads which use portable storage batteries and the results obtained indicate that a depreciation rate of 20 per cent per annum is conservative. Various methods of transporting the cells to and from the signals were described. The effect of the use of portable storage batteries on the reliability of the signal system is difficult to determine. From a theoretical viewpoint it would seem as if there should be a tendency toward greater reliability. In the discussion there were some who advocated the charging of stationary storage batteries by lines. Mr. Beck said that he did not wish to be understood as advocating portable storage batteries for cases where the traffic is heavy. The line-charging method should be used in heavy-traffic situations.

A paper on the "Generation, Control and Transmission of Alternating Current for Railway Signals," by Messrs. Frank R. Rhea and E. E. Kimball, of the General Electric Company, was read by Mr. Rhea. The authors described briefly some of the ways in which alternating current can be produced, controlled and transmitted for the operation of railway signals. In the discussion Mr. L. F. Howard, of the Union Switch & Signal Company, and a number of others took part. The authors of the paper predict that the use of alternating current will be extended in future signal installations on account of its being the only effective means of eliminating foreign current troubles. In their belief, it is practicable to design and construct alternating-current signaling apparatus. Mr. Rhea favors the three-phase motor for signaling, but Mr. Howard advocated the single-phase motor. On this point Mr. Rhea said: "The study I have made of the subject has been rather on the signal circuits themselves, and although it is not easy to figure out the circuits that will be necessary to use three-phase transmission and single-phase arrangement of signals, it is entirely practicable to do so, in my opinion. In doing so it will probably be necessary to put in a system of common wires, which ought to be done, and which many of the railroads are now doing for their direct-current work. The alternating-current system will force the introduction of this improvement, which is a good thing in itself."

Conduit construction was referred to in the paper and caused some discussion. Mr. W. H. Elliott, of New York (New York Central), made the interesting statement that the ducts that were installed in New York for the electric zone cost about $65,000 for 3½ miles of ducts. Vitrified ducts were used. It was found impossible to pull in cable for more than 400 ft. The ducts were laid in layers with four splicing chambers. When the apparatus was first installed two transformers were placed in the splicing chamber, and owing to water leaking in, it was necessary to go to the expense of putting boxes above the splicing chamber, so that the cost of underground construction in alternating-current work was rather heavy.

Maintenance of Way Association.

The eleventh annual convention of the American Railway Engineering and Maintenance of Way Association was held at the Congress Hotel, in Chicago, on March 15, 16 and 17. It followed the meeting of the Railway Signal Association, on March 14, and during the whole week there was an extensive exhibition of railroad appliances in the Coliseum under the supervision of the Railway Appliances Association. About 500 members of the Maintenance of Way Association attended the convention, while the total attendance of railroad men and visitors at the two conventions and exhibition reached a much larger number. The president of the association, Mr. William McNab, principal assistant engineer of the Grand Trunk Railway System, Montreal, presided. After he had presented his annual address, the committee on "Uniform Rules" presented its report, which was discussed at some length and then the report on "Signals and Interlocking," presented by Mr. A. H. Rudd, of Philadelphia (Pennsylvania Railway), was discussed. On the suggestion of Mr. L. C. Fritch, of the Chicago Great Western Railway, the committee accepted an amendment to its report, changing the requirement for voltage from 600 volts to 660 volts. The subject presented by the committee was such as had been previously discussed in the meeting of the Railway Signal Association, a report of which appears elsewhere in this issue. The committee presented majority and minority reports, and on the subject of the uniform system of signaling there was some divergence of opinion. This subject was referred back to the committee for further consideration.

REPORT ON ELECTRICITY.

A short report was received from the committee on "Electricity." Mr. George W. Kittredge, of New York, chief engineer of the New York Central Railroad, is chairman of the committee, and the report was in the nature of a progress report only. Announcement was made of the appointment of sub-committees, those dealing with electrical matters being as follows:

Transmission Lines and Crossings—Mr. R. D. Coombs, Pennsylvania Railroad, New York, chairman; Mr. A. S. Baldwin, Illinois Central Railroad, Chicago; Mr. Harwood. Insulation—Mr. H. R. Talcott, Baltimore & Ohio Railroad, chairman; Mr. Coombs, Mr. Fritch. Electrolysis—Mr. A. S. Baldwin, chairman; Mr. Drinker and Mr. Talcott.

The gentlemen named as constituting these sub-committees, with Mr. Kittredge, make up the full committee. The sub-committees were directed to prepare a history and bibliography

Although there is an appreciable sluggishness of the eye in adapting itself to various intensities of illumination, the iris eventually automatically opens to the proper aperture to permit the eye its highest sensibility. The great range of actual intensity over which the eye is able to see comfortably is illustrated by the readiness with which it perceives, for instance, a snow-bank lighted by the noon-day sun, and later, with a different adjustment of the iris, the same surface under a moonlight illumination having an intensity about 1/4000 that of the former. An interesting commentary is the ability of the artist to paint pictures of these subjects which may be hung side by side under the same gallery illumination, yet each of which is at once recognizable as possessing the quality of the illumination of the actual scene it represents, although upon examination the difference in shade of the moonlit and sunlit surfaces proves to be very slight.

The appreciation of actual shade values, as of colors, is also largely a matter of comparison, depending upon the illumination encountered. Thus a stick of charcoal, apparently one of the blackest substances, when brightly illuminated reflects approximately 50 per cent more light than the white surface of a cube of sugar or other similar substance under a limited illumination, in which, however, it is readily appreciated as white. The contrast between the printed letters on a white page affords another example of this phenomenon. Here the surface of the black letters reflects approximately one-fifteenth as much light as the white page. When it is recalled that the range of illumination through which such a page is comfortably legible represents a ratio of actual intensities of one to 200, we see how it may come about that at mid-day the black letters may actually reflect into the eye many times more light than does the white page itself under a reduced illumination which is yet sufficient for comfortable reading.

Dr. Gradle also spoke of the checking or inhibiting effect of a particularly bright glare upon all of the retinal image in the neighborhood of the brightly illuminated region. Thus at late twilight the houses seen across the street may become indistinguishable if a lighted lantern is held close before the eyes. However, when the lantern is removed, the dimly illuminated objects instantly spring into view, proving that their former invisibility was not due to the contraction of the iris (whose recovery would have been much more sluggish), but is in reality a phenomenon originating at the retinal surface itself. A similar effect is noticeable in distinguishing colors when some other color has been previously examined or is in the same field of vision. Under such conditions the eye's estimate of the color in question is largely modified. A certain shade also appears lighter or darker, depending on the color of the field with which it is surrounded. The real reason for the increased fatigue when attempting to read with insufficient light, even though the page is apparently quite visibly illuminated, as pointed out by Dr. Gradle is the diminished contrast between the light reflected from the black letters and the printed page.

In closing, Dr. Gradle referred to the most advantageous arrangements and qualities of light for artificial illumination, and spoke of the importance of diffused light, especially that from sources hidden from view, as in indirect lighting. Such indirect lighting the speaker considered to be theoretically correct, and testified that his own experience with such systems of illumination had borne out the results he was led to expect from the theoretical considerations of the oculist's standpoint.

During the discussion of the subject, which followed Dr. Gradle's talk, a visitor to the Electric Club, Mr. A. J. Marshall, of New York, secretary of the New York Section of the Illuminating Engineering Society, referred to the notable installation of indirect lighting in the new Union Station at Washington, D. C., and told of some experiments with this system of illumination that had been carried out in the lecture hall of the Engineering Societies' Building in New York. In the latter instance, he said, indirect lighting had seemed to prove a source of fatigue and drowsiness on the part of those seated in the room, and was accordingly considered unsuccessful. Uniform and unrelieved illumination of any kind, explained Mr. Marshall, tends to produce drowsiness upon an audience in a large hall or church, and to avoid this, he mentioned some experiments which had been suggested, for continually varying the illumination of such places from one 1 ft. to 2-ft. candles and back again, in a 15-minute period, by means of dimmers. The iris diaphragm would unconsciously follow such slow variations, which would act as a stimulus, or "massage" as Mr. Marshall expressed it, to the eye. As an alternative to the present crude system of printing with black characters on a white surface, which subjects the retina to much unnecessary fatigue, Mr. Marshall proposed, since the use of white letters or pigment on a black surface is beset with mechanical difficulties, to use amber-colored letters on a green background, a combination which gives both comfort and a large degree of contrast.

Mr. George H. Jones, of the Commonwealth Edison Company, Chicago, was called upon to recount his experience with indirect lighting in his home. He explained that as he has employed this scheme, using the ceiling reflection for general illumination, and amber-shaded lamps about the room for local lighting, the result has been entirely satisfactory and comfortable, and is favorably commented upon by all visitors.

Railway Signal Association.

A regular stated meeting of the Railway Signal Association was held at the Congress Hotel, Chicago, on March 14. The attendance was about 180, and Vice-President C. E. Denney, of Cleveland (Lake Shore), occupied the chair in the absence of President H. S. Balliet, of New York (New York Central), who was detained by illness. The morning session was devoted to the presentation of reports of committees. The first was that on "Signaling Practice," read by Mr. A. H. Rudd, of Philadelphia (Pennsylvania), the chairman of that committee. The committee reported against the use of upper left-hand quadrant signals. This is considered a radical change, and the point has been made that telegraph lines, electric service circuits, overhead trolley construction, etc., are increasing to such an extent as to require upper left-hand signals. The committee is of the opinion that it is possible that left-hand signals may be used on trolley roads, but as the tendency is to put wires underground as much as possible and remove them from places where they will conflict with the seeing of signals it thinks that upper right-hand rather than upper left-hand quadrant signals should be used for all new work and renewals. In the case of electrified steam roads the recent installations have been largely of the protected-third-rail type, where the construction does not obstruct the view of signals. The discussion brought out the fact that some of the railroads would be glad if they had the upper left-hand quadrant. It seemed to be the sense of the convention that when the report is made at the annual meeting (which will be held in October, possibly at Atlantic City) it shall not condemn the upper left-hand quadrant, but simply make plain the fact that the association does not think it proper to recommend it at the present time.

Various specifications relating to signaling apparatus were discussed. Then the committee on mechanical interlocking presented a progress report. Mr. C. J. Kelloway, of Wilmington, N. C. (Atlantic Coast Line), is chairman of this committee. The next report was that of the committee on power interlocking, for which Mr. B. H. Mann, of St. Louis (Missouri Pacific), reported as chairman. In the discussion of this report, Mr. R. C. Johnson, of New York (New York Central), explained that the New York subcommittee has in charge the drawing of specifications for electro-pneumatic interlocking. This subcommitte expects to have complete specifications ready for the annual meeting. Mr. I. S. Raymer, of Pittsburgh (Pittsburgh & Lake Erie), said that the Pittsburgh subcommittee is studying the question of electrical transmission to the apparatus to be operated. This subcommittee is considering underground transmission with wooden conduits and wires covered with asphaltum or pitch.

of the subjects under consideration, but otherwise will conduct their investigations in a manner that seems most desirable to each sub-committee. The whole committee is to meet bi-monthly.

A meeting of a sub-committee on "Clearances" was held some time ago at Detroit, at which reports of the committee on "Standard Location of Third-Rail Working Conductors" of the American Railway Association were discussed. No conclusion was reached, but it was the sense of the sub-committee that clearance between the limiting lines of equipment and the limiting lines of third-rail structures, shown as 1½ in. in the report referred to, is insufficient. It was decided to secure further data on this subject.

GENERAL BUSINESS.

Reports were presented from the standing committees on "Iron and Steel Structures," "Wooden Bridges and Trestles," and at an evening session there was a discussion on steel rails.

At the morning session of March 16 reports were received from the committees on "Economics of Railway Location," "Wood Preservation," "Ties," "Ballast," "Track" and "Standard Specifications for Cement and Masonry." The committee on "Wood Preservation," of which Mr. W. K. Hatt, professor of civil engineering in Purdue University, La Fayette, Ind., is chairman, presented revised specifications for tie treatment, specifications for analysis of coal-tar creosote and specifications for the determination of zinc in treated timber. Information was also presented on the use of crude petroleum, wood creosote and petroleum tar creosote. The committee has also collected data as to the relative strength of treated and untreated timber, and a list of wood preserving plants in the United States up to June 1, 1909, is included in the report.

After the presentation of this report, the president announced the result of the election of officers of the American Railway Engineering and Maintenance of Way Association by ballot as follows:

President, Mr. L. C. Fritch, chief engineer, Chicago Great Western Railroad, Chicago, Ill.; first vice-president, Mr. W. C. Cushing, chief engineer maintenance of way of Southwestern System of Pennsylvania Lines, Pittsburgh; second vice-president, Mr. Charles S. Churchill, chief engineer, Norfolk & Western Railroad, Roanoke, Va.; secretary, Mr. E. H. Fritch, 962 Monadnock Building, Chicago, Ill.; treasurer, Mr. C. F. Loweth, engineer and superintendent of bridges and buildings, Chicago, Milwaukee & St. Paul Railway, Chicago; directors, Mr. Robert Trimble, chief engineer maintenance of way of Northwestern System of Pennsylvania Lines, Pittsburgh, Pa.; Mr. F. S. Stevens, superintendent, Philadelphia & Reading Railway, Reading, Pa.

The annual dinner of the association was held at the Congress Hotel on the evening of March 16. The attendance was about 300, and President McNab was the toastmaster. Speeches were made by Hon. George P. Graham, minister of railways and canals of Canada; Mr. Ralph M. Shaw, of the Chicago bar; Dr. Harry Pratt Judson, president of the University of Chicago; Alderman Milton J. Foreman, of the Chicago City Council, and Mr. A. H. Rudd, of Philadelphia (Pennsylvania Railroad).

Thursday, March 17, was the concluding day of the convention. It was mainly devoted, like the preceding days, to the consideration of reports of standing committees. The committees reporting were those on "Buildings," "Roadways," "Records and Accounts," "Water Service," "Signs, Fences and Crossings" and "Yards and Terminals."

Resolutions of thanks to the *Railway Age-Gazette* and the *Railway and Engineering Review* for issuing dailies during the convention were adopted, also to the Railway Appliances Association for the fine exhibition at the Coliseum.

Mr. L. C. Fritch, the new president, was escorted to the chair and made a few remarks. He proposed a rising vote of thanks for the retiring president, Mr. William McNab, and the members rose and cheered that gentleman with enthusiasm.

VISIT OF PRESIDENT TAFT.

Just before the close of the convention a visit was received from the President of the United States, who was in Chicago on a St. Patrick's Day visit, and who kindly consented to appear at the convention and address the members of the association informally. President McNab, who is a Canadian, expressed in felicitous terms his appreciation of the honor of introducing to the convention the President of the country. He remarked that although the association is American in name and domiciled in the city of Chicago, it is not circumscribed by mere national lines. Mr. Taft expressed his pleasure at meeting the railroad engineers and said that at the time when he was a United States circuit judge he had a good deal to do with railroads because so many of them in that part of the country at that time went into the hands of receivers whom he appointed. "I was an undertaker," he said, "in the burial of I don't know how many railway companies in the Sixth Circuit, and in the reconstruction, under the system of receivers certificates, of thousands of miles of railroad. At that time I was able to follow with a good deal of interest the price of steel rails and how far a million dollars would go in helping along a railroad that needed new steel. I came then to know, what I ought to know anyway, that the maintenance-of-way man is the man after all into whose keeping is given the safety of 90,000,000 of people." The President concluded by alluding to the comforts and conveniences of railroad travel at the present time and the great advancement that has been made in these respects. In relation to safety in railroad travel, the President intimated that a large proportion of the accidents were due to the negligence of the public itself, and he spoke of the necessity of keeping the right-of-way free from trespass.

Massachusetts Commission Notes.

The Massachusetts Gas and Electric Light Commission has issued an order approving the issue by the Great Barrington Electric Light Company of new capital stock to the amount of 750 shares at a par value of $100 each, the proceeds to be applied to the payment of floating debt and the cost of future additions to the plant. The board has also issued an order rescinding the authority granted the company in 1903 to issue first mortgage bonds to the amount of $15,000, such issue never having been made by the company.

The Massachusetts Railroad Commission has approved the issue of bonds by the Boston & Worcester Street Railway Company to the amount of $450,000 to be applied to the payment of floating debt. The bonds are to run 20 years and carry 4.5 per cent interest. The board has issued a finding upon the petition of residents of Salem for improved conditions on the Essex Street line of the Boston & Northern Street Railway Company, in which the commission points to the probable mitigation of the situation by track reconstruction.

The Railroad Commission gave a hearing on March 21 upon the petition of the selectmen of Westboro for a 15-cent fare between Westboro and Worcester on the line of the Marlboro & Westboro Street Railway Company, and for the restoration of power-house operation in Westboro. President Dewey, for the railway company, stated that the road had never paid a dividend, and that it has a deficit of $24,000. It has never raised its fares to 6 cents, as have many similarly situated roads. The fares are the same as those on other lines of sparse population running out of Worcester for like distances. At Worcester passengers have full free transfer facilities. The company would be practically impoverished if the fare were cut. Regarding the restoration of power-house service, Mr. Dewey said that under the old conditions the company sold energy to the Westboro & Hopkinton Street Railway Company, which has now made other arrangements for the operation of its lines. The Westboro plant cannot be run economically upon the loads which are now carried by it, and it is therefore undesirable for the company to keep it in service. The board took the matter under advisement.

The Massachusetts Gas & Electric Light Commission gave a hearing on March 18 upon the petition of the Amesbury Elec-

tric Light Company for approval of an issue of $20,000 in stock and $20,000 in bonds for the purpose of paying outstanding indebtedness and the cost of further additions to the plant. The petitioner was represented by its counsel, Mr. E. H. Mather, who stated that the company's business has grown so rapidly that the present machinery is inadequate. Operation at considerable overloads for several hours daily is necessary. During the winter months just passed the output at the switchboard increased about 65 per cent over the output during the corresponding months of the previous winter with the same generating apparatus. On account of the motor load the equipment must be increased to meet the demands of the coming summer, when the present overloads cannot be handled on account of the increase in temperature. The estimated cost of the improvements planned is $24,451. The anticipated costs are shown in detail in the following table:

ESTIMATED COST OF POWER PLANT IMPROVEMENTS, AMESBURY, MASS, 1910.

Engine, 16 x 32 x 32-in. Rice-Sargent, condensing	$8,600
Freight and teaming, erecting	350
Generator, 2-phase, Gen. Elec., 2300 volts, 60 cycles, 370 kw	3,800
Freight and teaming	70
Motor-generator for exciter	1,100
Two 15-kw transformers	306
Two switchboard panels	600
Wiring	100
Boiler, 72 in. x 16 ft., horizontal return tubular	900
Foundation and setting, piping	500
Piping to engines and auxiliaries	1,100
Smoke flue	70
Condenser pump, 8 x 14 x 12-in., single	390
Condenser, 12-in. spirojector	215
Boiler feed pump, 7½ x 5 x 12-in. duplex	250
Engine foundation	1,050
Feed water heater, 500 hp	350
Pipe covering	150
New roof with trusses (steel, to reduce insurance)	1,060
Concrete floor around new engine	150
Removing old roof	200
Bricking up opening, new engine room	225
Partition between engine and boiler room	150
Additional freight and teaming	75
Paving boiler room floor	70
Oiling system, 2 engines	400
Contingencies 5% and engineering 5%, total 10%	2,220
Total cost of 370 kw extension or $66 per kw.	$24,451

Mr. Mather stated that old machinery costing $8,200 and having a present value of $2,000 would be replaced by the above equipment. The assets of the company are $147,219; its gross earnings for the year ending Feb. 28 were $41,844, and its operating expenses and taxes $25,389. The past two and three-quarters years the company has expended $16,275 upon construction and improvements. The board took the case under advisement.

Canadian Hydroelectric Commission News.

The Municipal Electric Commission of the city of Ottawa will make application to the Hydroelectric Commission for a supply of 1500 additional horse-power.

City Electrical Engineer Roberts has reported to the London, Ontario, water commissions that the cost of installing an underground distribution system in the down-town district would be about $39,050.

On the recommendation of Chief Engineer P. W. Sothman, of the Hydroelectric Commission, the London, Ontario, water commissioners awarded a contract on March 19 for electric power equipment, dividing the work almost equally between the Canadian Westinghouse and Canadian General Electric Companies in the sums of $24,781 to the former and $25,745 to the latter.

New York Public Service Commission News.

The Public Service Commission of the First District last week modified its order, issued Feb. 13, which required the Interborough Rapid Transit Company to place in every new subway car storage batteries sufficient to maintain four 12-cp lamps. The modified order requires only two 12-cp lamps to be maintained. The order also requires that the platforms of subway stations shall be illuminated sufficiently for passengers to read conveniently.

The commission has given permission to the New York City Interborough Company to open a new cross-town surface line in the Bronx running from the subway station at 181st Street and St. Nicholas Avenue to Westchester Creek. The new line is about two miles long and is ready for operation.

The transit committee of the Board of Estimate and Apportionment will hold a public he ring April 1 at which any citizen will have an opportunity to express himself with regard to the proposed subway routes laid out by the Public Service Commission. This hearing is entirely independent of the commission.

Representatives of the New York City electric lighting interests made formal protest before the Assembly Railroads Committee at Albany last week against the passage of the Parker bill. This measure proposes to increase the authority of the commission of the First District over gas and electric companies. The representatives of the companies declared that the business now has all the regulation it can stand.

A bill was introduced in the New York Legislature last week which provides that the members of the Public Service Commission of the First District shall be appointed by the Mayor of the city instead of by the Governor and that the Mayor shall also have the power of removal.

Massachusetts Legislative Notes.

The time for public hearings on matters before the various committees of the Massachusetts Legislature is gradually drawing to a close, and special efforts are being made to conclude arguments and reports in order to avoid any needless prolongation of the session. A feature of the present session which has helped considerably in the progress of business has been the disinclination of committees to postpone hearings, in contrast to the opposite policy noted in some recent sessions. Of the various matters of interest to public-service corporations before the committee on metropolitan affairs, the principal remaining hearings are those upon the proposed electrification of steam railroads in the Boston district, and the proposed tunnel of the Boston & Eastern Electric Railroad Company under Boston Harbor. A hearing was concluded last week by this committee on the bills to construct subways to South Boston and Dorchester. President Bancroft, of the Boston Elevated Railway Company, appeared in opposition, stating that for the present the company desires not to be burdened with any more costly underground tunnels, an exception being made by the company's willingness to have the Boston Transit Commission prepare plans for a subway from Park Street to the South Station. The company is now committed to extensions costing $31,550,000, and must earn net to carry these $1,786,312 per year more than its present revenue. General Bancroft said that since the Boston Elevated took hold of the system the length of track had been increased from 304 to 484 miles, the investment rising from $31,000,000 to $85,000,000. The revenue has increased only from $8,750,000 to $14,500,000. In conclusion he said that the time will come when there will be an extension of subways, and suggested that this might be hastened by allowing the company longer leases than heretofore.

The committee on street railways has voted leave to withdraw the Heneberry bill to provide that cities and towns may authorize street railways to transport freight without the approval of the Railroad Commission. The plan of this bill was to give the companies limited franchises, and the project was vigorously fought by the street railways. Leave to withdraw was also given to the Kelly bill authorizing street and elevated railways to transport freight and express matter.

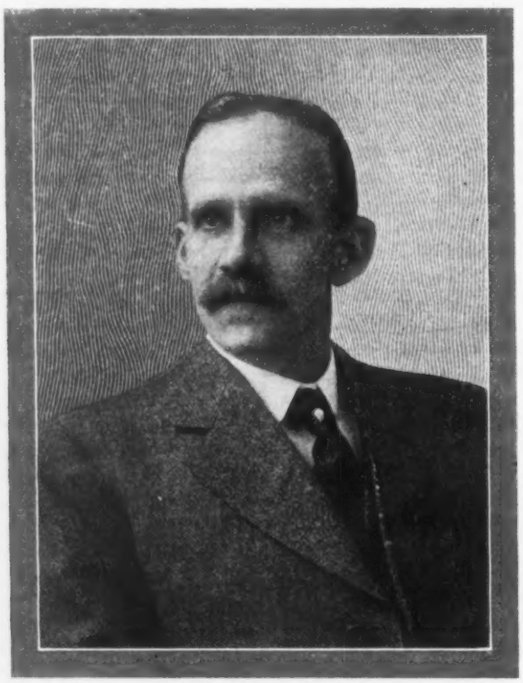
The town of Brookline has adopted resolutions favoring the electrification of all steam railroads within the Boston metropolitan district, and these will be brought before the Legislature. The Kiley bill to create public-service commissions for the supervision of public-service corporations has been reported adversely by the committee on public service. An adverse report has also been received on the bill to extend the Washington Street tunnel from its southern terminus to Dudley Street, Boston, and an unfavorable report has been received on the Mellen bill to provide for the establishment of street railway waiting rooms, the latter having been accepted by the House.

The committee on public lighting has been requested to give a hearing on a petition to allow the Norfolk & Bristol Street Railway Company to furnish electricity in certain towns for heaters, lamps and stationary motors. The Senate has accepted the report of the committee on street railways referring to the next session the establishment of a transfer station at Huntington and Massachusetts Avenues, Boston. The House has accepted the adverse report of the committee on street railways on the bill to provide for State and city ownership of street railways. The resolution to provide for an investigation of electrical transmission has reached the second stage in the House, after being passed to be engrossed by the Senate.

AMERICAN ELECTRICAL ENGINEERS—VIII.

S. T. Dodd.

Samuel Thomson Dodd was born Jan. 30, 1866, at Ningpo, China, his parents being missionaries connected with the Pennsylvania Board of Foreign Missions. He came to the United State in 1878, and received his primary education at the Huntington Union School, Huntington, L. I. He entered Princeton in 1883, and on graduation in 1887 was awarded the J. S. K. mathematical fellowship for the following year. The period



Mr. S. T. Dodd.

1887 to 1889 was passed in post-graduate work in mathematics and in physics, and from 1889 to 1893 he was engaged as laboratory assistant and tutor in physics and electrical engineering, the Princeton University School of Electrical Engineering having been organized in 1888 under Dr. Cyrus F. Brackett. Mr. Dodd received from Princeton the degree of A. B. in 1887, A. M. in 1888 and of E. E. in 1893.

In 1893 Mr. Dodd left Princeton to enter upon practical work, and spent a year in the testing and construction departments of the Brush Electric Company, Cleveland, Ohio. During this time he was especially engaged in the development of the Brush 100 and 125-light arc machines, which were the first commercially successful machines of these large capacities. In 1894-1895 he became connected with the Newark and Jersey City street railway system. This was the period of the consolidation of the smaller roads in that section of New Jersey, which resulted in the concentration of car repair work in the Plank Road car shops. Mr. Dodd was for a time foreman of the Broad Street, Newark, car barn, and was appointed foreman of car repairs at the Plank Road car shops upon their competition.

From 1895 to 1899 Mr. Dodd was connected with the Walker Company, of Cleveland, Ohio, first as designing engineer of direct-current generators and motors, and later as assistant engineer in charge of design, testing and installation. During this time he was, under the late Prof. Sydney H. Short, chief engineer of the Walker Company, directly responsible for several notable electrical designs. Among these may be mentioned the first electrical generators for the Brooklyn Bridge, the first railway motors for the Brooklyn Elevated Railway and the first 2700-kw generators for the Boston elevated system. At this time the Walker Company was making a study of electrification of elevated and surface roads in New York City, and Mr. Dodd developed a method of studying the relation between the speed and power consumption of electric trains, the method being based upon the fundamental mechanical and electrical principles involved, as contrasted with previous empirical treatments of the problem. The method which thus originated has since been developed into that of speed-time curves now universally applied in the consideration of traffic problems in electric traction. What is probably the first published description of the method of the calculation of speed-time curves is given in an article by Mr. Dodd entitled "Proper Handling of Controllers," which appeared in the *Street Railway Journal* of August, 1897.

Upon the absorption of the Walker Company by the Westinghouse Company in 1899, Mr. Dodd went with the Link Belt Machinery Company, of Chicago, Ill., and took up engineering and commercial work relating to electric mining machinery, particularly in connection with the application of electric power to the bituminous coal mines of Ohio, Indiana and Illinois. From 1901 to 1904 Mr. Dodd was connected with the Stanley Electric Manufacturing Company, of Pittsfield, first as engineer and later as manager of the railway department, with direct charge of engineering and sales of electric railway apparatus. He designed and developed the line of Stanley railway motors and obtained patents upon a series-parallel controller, which it was proposed to use with Stanley electric railway equipment. The essential feature of the invention was the control of motor speed by means of a series of field combinations, a feature which enabled him to obtain a practical series-parallel control without infringing upon the claims of existing patents. Mr. Dodd has contributed a number of articles and discussions to technical journals and to the transactions of various societies upon subjects related to heavy railway work. Several of these papers are on the subject of design of motors and locomotives, among which may be mentioned a paper in the anniversary issue of the *Street Railway Journal*, October, 1904, on "The Development of Railway Motor Design" and a paper before the Asheville meeting of the American Institute of Electrical Engineers upon "Weight Distribution on Electric Locomotives as Affected by Motor Suspension and Drawbar Pull."

Mr. Dodd is a member of the American Institute of Electrical Engineers, the Society of Engineers of Eastern New York, The Princeton Club, of New York, and the Mohawk Golf Club, Schenectady.

CURRENT NEWS AND NOTES.

San Francisco Electrical Show.—The Pacific Coast Electrical Exposition will be opened at San Francisco, May 21.

Sons of Jove at Memphis.—A chapter of the Sons of Jove has been instituted at Memphis, Tenn., by Mr. E. D. Strickland, national organizer.

Wireless Oscillators.—At a meeting of the Wireless Institute, to be held in the physics lecture-room of the College of the City of New York, on April 6, at 8:30 p. m., a discussion on "Experimental Tests of the Radiation Law for Wireless Oscillators" will be opened by Prof. M. I. Pupin.

Washington Electrical Show.—Arrangements are being completed by the dealers in Washington for an exhibition of house furnishings and electrical appliances. The exact date for the show has not been set, but it is stated it will be in October or early in November. It probably will extend over two weeks.

Gas Competition in Southern California.—The Pacific Light & Power Corporation, Los Angeles, recently incorporated to take over the Pacific Light, Heat & Power Company, which operates several water-power and steam electric plants in southern California, has acquired several gas plants in the Los Angeles district, and will expend over $3,000,000 in constructing a high-pressure gas supply system.

Testing Wireless Interference.—Tests are now being conducted by means of constant communications betwen the naval wireless station at Newport, R. I., and the navy yard at New York in order to secure data as to the extent of the interference of the service by amateurs and others. When the tests have been completed the results will be forwarded to the Navy Department. Serious delay to the Government wireless service has been caused, it is said, by outside operators, chiefly amateurs.

British Electrical Industry Organization.—A movement is on foot to organize a body in Great Britain to further the legislative, industrial and commercial interests of the electrical industry. A number of leading electrical engineers and others connected with the industry have constituted themselves a provisional committee on the subject, with Mr. R. Borlase Matthews as honorary secretary. It is stated that every effort will be made to work in cooperation with existing electrical societies.

Withdrawal of Water-Power Sites.—Secretary Ballinger has temporarily withdrawn 56,659 acres of public lands from all forms of disposition in aid of proposed legislation affecting the disposal of water-power sites on the public domain. The withdrawals are located as follows: 42,459 acres along Yampa, Col.; 3560 acres along White River, Col.; 5480 acres along Grape Creek, Col.; 2240 acres along Deschutes River, Ore.; 1720 acres along Willow Creek, Ore., and 1200 acres along Bear River, Wyo.

Iowa Electric Light Conventions.—The Iowa Electrical Association is to hold its annual convention at Sioux City April 20 and 21. The Iowa Street & Interurban Railway Association holds its convention at the same place April 21 and 22. There will be the usual exhibit or electrical show held during these conventions. The show and the Iowa Electrical Association sessions will be at the Auditorium. The Iowa Street & Interurban Railway Asociation will meet at the West Hotel. The principal hotels are the West and the Mondamin.

Radio-Active Matter.—In a recent address before the Authors' Club, in London, Sir William Ramsay expressed the opinion that polonium, which has recently been isolated from radium, requires 1750 years for a 50-percentage transformation from radium. It represents the greatest concentration of energy at present known. The characteristics of radio-active matter will be discussed fully in a lecture to be delivered before the Royal Institution, London, by Prof. William H. Bragg, of Adelaide University, on May 13.

Denver Electric Club.—Prof. Milo S. Ketchum, Dean of the College of Engineering of the University of Colorado, gave an interesting talk on engineering education and the movement for trade-school education over the United States at the March 24 luncheon of the Colorado Electric Club. A chalk talk was also given by "Doc Bird," of the *Denver Post*. The senior and junior students of the University of Colorado Engineering School were luncheon guests of the Westinghouse Company, the total attendance being 190.

Resuscitation.—Dr. Louise G. Robinovitch delivered a lecture entitled "Resuscitation by Means of Electric Currents of Subjects in a Condition of Syncope Caused by Electrocution," on March 23, under the auspices of the New York Electrical Society. The lecture was illustrated by lantern slides giving a number of tracings showing the effect of the current in creating first an artificial action of the heart and lungs, and finally in restoring the natural action.

Engineering Fellowships.—Among the fellowships offered by the University of California open to the graduates of this and other colleges and universities are 12 for engineering students. There are 10 University fellowships yielding $400 each and two John W. Mackay, Jr., fellowships in electrical engineering yielding $600 each. Candidacy for fellowships is, in general, restricted to students who have completed at least one year of graduate work, and who intend to proceed to the degree of Doctor of Philosophy, or its equivalent.

Michigan Power Merger Abandoned.—The proposed merger of a number of Michigan electric-lighting and traction companies, for which a bond issue of $35,000,000 was recently petitioned, has been dropped. The hearing of the application of the Consumers' Power Company, which was the name of the proposed combination, was to have come before the Michigan State Railroad Commission this month, but a representative of the promotors, Mr. John C. Weadock, now announces that all present prospect of the merger has been abandoned.

Car and Car-House Wiring.—At the 1908 convention of the American Street and Interurban Railway Engineering Association the matter of a convenient form of reference to the rules of the "National Electrical Code" referring to car and car-house wiring, preferably in the form of a special codification of these rules, was brought up. The association considered such a codification impracticable, and instead has got out an index to all of the rules of the code relating to car and car-house wiring, which will be distributed to the associate members and member companies, with the suggestion that it be pasted in the back of a copy of the code as a means of reference.

St. Louis Company N. E. L. A. Section.—On March 21 the Union Electric Light & Power Company of St. Louis gave a dinner to those of its employees who have joined the recently formed company section of the National Electric Light Association in St. Louis. About 160 officers and employees of the company, who constitute the membership of the Union Electric Light & Power Company Section of the N. E. L. A., were guests at this dinner. Officers were elected as follows: President, Mr. Alten S. Miller; first vice-president, Mr. K. H. Hansen; second vice-president, Mr. John Anderson; secretary, Mr. C. E. Brenton; treasurer, Mr. Thomas W. McClelland. In proportion to the size of the company and to the population served this new company section in St. Louis stands perhaps at the head of the list of N. E. L. A. company sections.

Decision Against Electrician in Accident Case.—The Supreme Judicial Court of Massachusetts has issued a decision in favor of the defendant in the case of a suit brought by an electrician who was severely injured by a short-circuit caused by his attempting to strip a lead-covered electric railway cable with a screwdriver, acting under the direction of the foreman, the cable being alive at the time. The court held that the employer is not responsible for the act of a fellow-servant under the common law; that no authority exists for the assumption that the railway current might have been shut off on request, since the injury to traffic might preclude such action; and that the plaintiff, by experience as an engineer and electrician with manufacturing, railway and steamship companies, was naturally cognizant of the dangers attending his work. The decision sets aside a finding by the jury of the lower court of damages to the extent of $30,000.

N. E. L. A. Convention.—The exhibition space for the coming St. Louis convention of the National Electric Light Association has been taken up more rapidly than in previous years. All of the available space, excepting about a dozen sections, has already been assigned.

April Meeting of the A. I. E. E.—The date of the regular April meeting of the American Institute of Electrical Engineers has been changed from Friday, April 8, to Friday, April 15, 1910. At this meeting a paper by Dr. Samuel Sheldon, entitled "Education for Leadership in Electrical Engineering," will be presented and discussed. The meeting will be held in the Engineering Societies Building, New York, under the auspices of the educational committee of the Institute.

Subway for Montreal.—It is stated that as soon as the necessary permission is obtained through the Quebec Legislature, the Montreal Street Railway Company will begin the construction of a subway under St. James Street. The subway will extend from the Champ de Mars to Victoria Square, in the heart of the city, and is intended to relieve the congestion from the present surface system. This section will cost $1,500,000 and will take a year to construct.

Regulation of Wireless.—According to a proposal which has been approved by the Navy Department and the Department of Commerce and Labor and has been submitted to the House of Representatives, wireless telegraph stations must be licensed and the operation of an unlicensed station will be made a misdemeanor, for which a fine of $500 can be imposed. The President may in time of war or public peril order any station closed. Interference with messages, which has been the source of much trouble, is placed under a penalty of $500. The fee for first-class licenses, which are those for land stations, will be $100 and that for the second class, those on ships, is to be $5. Messages relating to ships in distress are to have priority. Fraudulent messages are forbidden and a fraudulent distress signal may be punished by a fine of $2,500 and imprisonment for five years. The House merchant marine committee has determined to report favorably upon a bill requiring the equipping of ocean-going steamers with wireless telegraphic apparatus.

Proposed Additional Water-Power for Sanitary District of Chicago.—The Chicago City Council has joined with the Sanitary District and other Illinois State officials in urging the Federal Government to permit the construction of the Sag intercepting drainage canal, which will reverse the flow of the Calumet River, discharging the overflow from Lake Calumet with its sewage contents into the Drainage Canal at a point near Sag, Ill. The present flow through the Drainage Canal from the Chicago River inlet is 10,000 cu. ft. per second. The Government engineers fear that the additional demand of 4000 cu. ft. per second will result in lowering the lake so much as to affect some of the harbors. The cost of the Sag channel, preliminary work on which was begun some time ago, will be between $10,000,000 and $20,000,000. If the permission of the Federal Government is granted for the completion of the Sag channel, a total flow of 14,000 cu. ft. per second will thus become available for the Sanitary District's hydroelectric development at Lockport.

Telephonic Transmission of Odors.—Alderman Jacob A. Hey, of the Chicago City Council, has been a leader in the recent local investigation into the sale of pasteurized milk. Following this campaign, the telephone bell in his committee room rang, one day last week, and as the Alderman lifted the receiver from the hook, he thought he detected a faint odor suggestive of incipient putrescence. "Hello," said the voice in the telephone, "I want to congratulate you on your efforts in this pasteurized-milk campaign. I have had considerable experience with pasteurized milk myself." Something seemed to offend the Alderman's nose just then, for he motioned to his assistant to throw up the window, and then, interested in his caller, edged nearer the 'phone. "I have been drinking pasteurized milk constantly for three months," continued the voice, "and it has so interfered with my digestion that perhaps you can detect it on my breath even over the 'phone." By this time the aroma had grown so overwhelming that no further clew was needed to the joke being perpetuated, besides the thin film of healthy and active limburger cheese found coating the inside of the transmitter. Other calls came in during the day, but the Alderman took no further part in the experiments involving the telephonic transmission of olfactory sensations.

An Early Electrical Inventor.—The March issue of *The Pennsylvania German* contains an interesting article by Mr. James B. Laux giving an account of the inventions and scientific work of Dr. David Alter, a physician of Armstrong County, Pennsylvania, who died at Freeport in that county in 1881 at the age of 74. It is stated that he applied for a patent on an electric telegraph "four years prior to the date of Morse's patent," but that his application was rejected on the ground that the idea was "absurd and chimerical." It is unfortunate that the date, which appears to have been in the early forties, is not specifically given. His system comprised seven wires, each with a separate terminal helix, and by right and left deflections 14 movements were obtained, through combinations of which messages are stated to have been transmitted over three miles of wire. This rather crude system was, however, antedated by some years by the single-needle systems of Schilling, Gauss and Weber, Davy, Wheatstone and Cook, all prior to 1837, and had nothing in common with the Morse electromagnetic system of 1837, first practically operated in 1844. It is also claimed that he invented an electric motor in 1837, but in this he was also anticipated by others. The chief claim made for Dr. Alter is the invention of spectrum analysis in 1854, which was made the subject of a paper that appeared in *Silliman's American Journal of Science and Art* in November of that year. It is claimed that Kirchoff, to whom the discovery is assigned with a date stated to be six years later than that of Alter, deliberately ignored the prior work of Alter.

Vienna Municipal Central Station.—The *Neue Freie Presse* for March 11, 1910, contains a review of the large electrical enterprises carried out by the municipality during the administration of the late Mayor Dr. Lueger. The original municipal electric power plant was finished by the Austrian Schuckert Works in 1901 at an expense of 33,170,000 kroners, but with the additions since made, the total investment has reached 63,010,000 kroners (one kroner = 20.3 cents). After a bitter struggle, the municipality managed to secure possession on May 1, 1908, of the International Electric Company for 19,110,000 kroners and of the Vienna Electric Company for 5,300,000 kroners. The municipality endeavored to buy up the private companies as early as 1901, and while it connected its system to dwellings, Mayor Lueger forbade the private company to do the same thing. The city endeavored to have the police carry out this prohibition, but this aid being refused, the Mayor made use of the fire department in destroying connections installed by the private companies. In consequence of this arbitrary action and the evident determination of the municipality to control the electricity situation at any cost, the private companies sold their properties. Up to the present time, the city has succeeded in paying all fixed charges on its electrical investment and during the last year had even a surplus of 5,750,000 kroners. This profit has, however, only been obtained by reason of the very high price for electrical energy charged against the municipal street railway system, so that it is a case of robbing Peter to pay Paul. Moreover, the original estimates for the cost of the completed system were exceeded by 22,500,000 kroners and the consumers have had no benefit from municipal ownership so far as a reduction in the price of electrical supply is concerned. The ambition of the municipality to have a complete monopoly of electrical supply has not yet been achieved, as there is still a private company known as the Austrian General Electric Company which carries on a large business.

HYDROELECTRIC PLANT, WITH STORAGE.

Forty-six Thousand Volt System of the La Crosse Water-Power Co., of La Crosse, Wisconsin.

BY R. A. LUNDQUIST.

ONE of the largest hydroelectric stations operating in the Middle West is that of the La Crosse Water-Power Company, which has now been in service for about one year. The energy is obtained from the Black River at Hatfield, Jackson County, Wisconsin, the dam being located at the head of what was known in the logging days as the "Mormon Riffles."

The idea of harnessing these rapids was conceived many years ago, but was not practicable at that time, as there was no demand for the energy, and, furthermore, certain flowage rights were not available then, being held by a corporation of lumbermen who had improved the river for the logging industry by building piers, dams, etc., along its length. Upon the wane of the lumber industry, the water rights were acquired, together with the necessary lands adjacent, and the preliminary steps in development were taken. The actual construction work was commenced in April, 1907, and an immense crew of men was engaged to carry the work through with the utmost possible dispatch, so that by December of that year, the dam, canal head-works, part of the canal, the substructure of the power house and the excavation for the tail-race had been completed, whereupon, by reason of the severity of the winter season, work was suspended until early in the spring of 1908. The remainder of the project was then carried to completion with the utmost possible rapidity and late in December, 1908, the equipment was ready for operation.

The dam is of monolithic concrete construction of the approved "Ogee" section, 52.5 ft. in height and 52.5 ft. wide at the base; the length of the spillway, between abutments, is 494 ft. The foundation for the entire work, spillway, abutments and core walls, is a solid ledge of granite, the thickness of which was determined to be at least 150 ft., so that the foundation for the entire work is of an excellence seldom met with in practice.

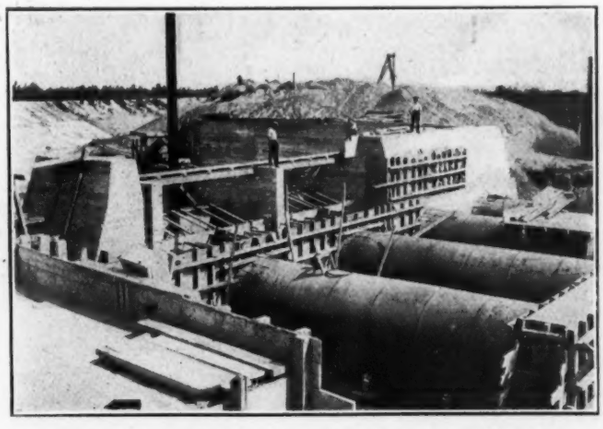


Fig. 1—Penstock and Headworks During Construction.

The site of the dam being across the lower end of an island, the work was commenced by building a rock-filled crib coffer dam from the upper end of this island to the west shore, thus diverting the water to the east channel, so that with a low coffer dam at the lower end of the island the bed of the river was drained, thereby allowing the work to proceed. The river bed was then stripped of all rubbish and loose rock and an anchorage was prepared in the solid granite.

In the meanwhile a concrete mixing plant was established upon each side of the river and trestle and a track was built for handling the concrete into the dam. The forms were then erected in 40-ft. sections and concreting commenced, the concrete being run out in dump cars over the trestle extending from the mixers to the forms, the forms being brought up 6 ft. at a time. In this half of the dam temporary openings were left large enough to carry the entire flow of the river, while the construction of the east half of the dam was proceeded with along the same lines as the first half; these openings were closed after the work was complete and the concrete had been allowed to set sufficiently.

Into the crest of the dam are set I-beam stanchions carrying the flash-board system by means of which the level of the pond can be raised 5 ft. above the crest elevation, thereby adding very materially to the storage capacity of the lake or reservoir. This reservoir, which in reality appears to be a natural lake, is about six miles long and a mile wide and gives a storage sufficient to tide over a dry spell. The available head is 94 ft.

In connection with this arrangement may be mentioned the fact that, owing to the grandeur of the scenery along the lake, the beautiful camping sites, together with the splendid boating and fishing, it is expected that quite a snug little revenue will be realized from the rent of the cottages and the boats and launches which the company maintains for the use of visitors. The lake has also been well stocked with game fish, and the locality is becoming famous as a fishing resort. In accordance with the approved designs of the State Fisheries Commission, a fishway of the Nova Scotia type has been provided at the east end of the dam.

Extending beyond the east abutment is an earthen core wall about 1200 ft. long which protects the railroad embankment from any possible wash during a period of unusually high water. The wall is of concrete built up from bed rock, so that there is no possibility of any seepage. A similar core wall, about 500 ft. long, was also built out on the west side of the river, with the canal intake gates located between the end of this and the main spillway abutment.

The intake gate headworks are of concrete, with an extreme inside width of 60 ft.; two concrete web walls divide the headworks into three equal spaces in each of which is set a Taintor gate. These gates are of the usual type and construction and are arranged to be operated by means of "crabs" mounted directly above, a brick structure 70 ft. by 10 ft. housing the operating mechanism. Stop-log recesses are provided on each side of each gate so that any one of the gate pits may be easily drained to facilitate repairs to the gates.

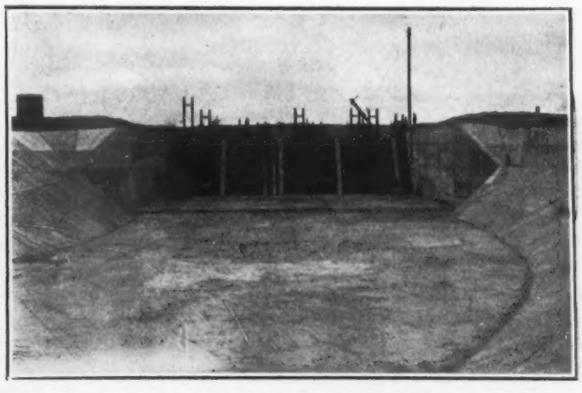


Fig. 2—Forebay and Penstock Headworks After Completion.

The concrete walls of the intake to the canal are extended for 300 ft. and an auxiliary spillway is provided by making the first 100-ft. section on the river side only 5 ft. higher than the crest elevation of the main spillway, so that, in cases of unusual flood, part of the waste water can be taken care of over it.

The Green Bay & Western Railway crosses the river just below the dam, and in order to bring the canal walls up to the proper height it was necessary to raise by 5 ft. the bridge spanning the river; the company was also obliged to furnish a two-span plate girder bridge over the canal at this point to provide a crossing for the railroad.

Commencing at the end of the concrete work, from the headworks down below the railroad crossing, the canal walls are

Fig. 3—Penstocks Near Power House.

the natural earth embankment thrown up by the excavators, the slope being 2 to 1, with a 3-ft. berm up 15 ft. from the bottom. For the first three-quarters of a mile, the width of the canal remains at 60 ft., but from there on the necessity of caring for a considerable volume of water from the two ravines traversed demanded an increase in the cross-section and its width was made 100 ft. for the remainder of the way.

As the canal is 2.6 miles long and represented a large item in the total cost of the development, considerable study was given to respective methods of carrying on the work, as a total of 400,000 cu. yd. of dirt had to be moved in a short space of time. After a thorough investigation of various methods and appliances it was decided to use an excavator of the drag-bucket type, and accordingly three of these with 1.5 cu. yd. buckets were put in commission. They did the work in a very satisfactory manner, throwing up 45-ft. or 50-ft. embankments in places and handling on an average 850 cu. yd. a day each.

The canal terminates in forebay headworks, very much similar to those at the intake, there being 90-ft. wing walls on either side; these are of reinforced concrete set on sheet-steel piling driven for a cut-off and are made monolithic with the end wall, into which are set the forebay head gates; in front of these gates are trash racks built up of wrought-iron bars in the usual manner and extending across the entire face of the end wall.

The end bell for four 10-ft. and one 3.5 ft. penstocks are set in this end wall, but at the present writing, only two of the large and the one small one have been put in; these penstocks are 225 ft. long and, leaving the end wall, they run horizontally for about 90 ft., then down the hillside on a 2.5 to 1 slope, finally entering the power house horizontally and connecting to the top of the wheel casing through an elbow, so as to distribute the water equally to both runners. Concrete saddles support the penstocks at 16-ft. intervals, and a reinforced concrete jacket covers them for the entire length.

The power house is 57 ft. by 146 ft. inside walls, with a height of 42 ft. and is built of red brick with concrete trimming; the frame of the building is of steel and the roof is supported by Fink trusses with channel-iron purlins; the roof covering is slate. On the inside, the power house is not partitioned off, excepting that there is a switchboard gallery in the south end under which there are compartments for transformers, high-tension buses and lightning arresters.

The present installation consists of two 4000-hp McCormick turbines, to each of which is directly connected a 2400-kw, 2300-volt, General Electric, three-phase generator, operating at 300 r.p.m.; the speed of these units is controlled by Lombard governors. There are two 100-kw, 125-volt exciters, the wheels for the two being fed with water from the one 3.5-ft. penstock.

The generators feed energy through oil switches into the 2300-volt buses from which the low-tension side of the transformer bank is fed through similar switches. The high-tension leads of the transformers tap on to the 46,000-volt buses from which the transmission line is fed through an oil switch. All of the low-tension wiring is carried in conduit and the high-tension in brick and concrete slab compartments. Disconnecting switches are provided so that the line may be opened just below the outlet tubes.

At present there is one bank of transformers installed, with one spare unit; they are of the oil-insulated water-cooled type, 2300 volts on the low-tension side and 26,550 volts on the high-tension side, star connected, so that the e.m.f. between line wires is 46,000 volts; the entire system is operated with neutral grounded with no resistance in series. These transformers are set in brick compartments, as before mentioned, upon iron trucks so that any one of them can be quickly pulled out and replaced with the spare unit.

The switchboard, which is located on the gallery forming a roof for the transformer and high-tension bus compartments, is of black slate and is comprised of four generator, two exciter and two transformer panels, two generator and one transformer panels being not in use for the present. The switchboard is provided with instruments of the horizontal edgewise type.

Above and back of the board are the outlets for the transmission line, a two-part porcelain insulator, set in a concrete slab being used; these are recessed in the wall with the bottom of the slab so placed as to make a 30-deg. angle with the vertical, thus obtaining protection from the weather.

Aluminum-cell arresters in connection with choke coils of the hour-glass type are installed and have given excellent results; they are equipped with the combination horn-gap disconnecting switches.

The transmission line consists of about 52 miles of steel-tower and 25 miles of wooden-pole construction; the towers are set 11 to the mile and the poles 42, excepting where unusual conditions exist. A 50-ft. right-of-way was acquired throughout the entire length of the line, excepting, of course, where the

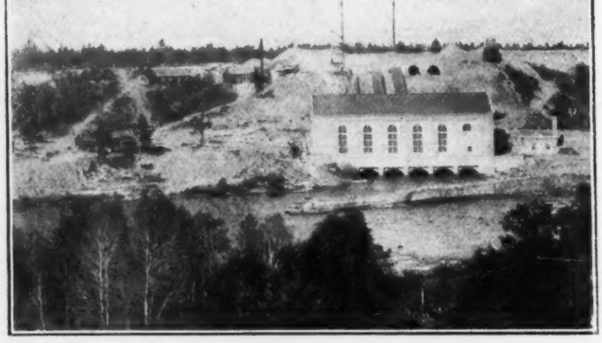


Fig. 4—General View of Power House.

line is built along the public highways, where ample trimming privileges were secured so as to avoid any possible danger from limbs of trees, etc., being carried onto the line by the wind.

All of the towers are of the single-circuit type, with a ground wire at the peak, the line wires being arranged in the form of an equilateral triangle, 6 ft. on a side; a private telephone line is carried on the towers 7 ft. below the lowest conductors. The lowest conductor on the towers is 50 ft. from the ground except in cases where it was necessary to grade the line to counteract the influence of abrupt changes in the profile of the ground; at railway crossings or where the high-tension line

crosses a telephone line, 60-ft. towers are used so as to give ample clearance.

For the wooden pole line, 40-ft. cypress poles, with 9-in. tops, were used; they are equipped with one 5-ft. cross-arm and one 8-ft. cross-arm. These cross-arms are of long leaf yellow pine, 5 in. by 7 in., and are fastened to the pole with a 0.75-in. through bolt; 1.5 in. by 0.2 in. galvanized iron braces 22 in. and 28 in. long are used with a 0.5-in. by 6-in. heel bolt.

The 5-ft. arm is at the top and carries one high-tension insulator and the ground wire support, while the 8-ft. arm, 5 ft. 7 in. below, carries the other two high-tension insulators; the telephone line is carried on malleable iron brackets with porcelain insulators, 5 ft. below the lower cross-arm.

The line conductors are of stranded copper, medium hard drawn, made up of seven strands of No. 10 wire, giving a section slightly larger than No. 2 B. & S.; on the tower line the ground wire is of the same size and material as the line conductor, but on the pole line No. 5 hard-drawn copper is used for this purpose. The telephone line on the towers is of No. 5 hard-drawn copper and on the poles is of No. 10 hard-drawn copper.

Fig. 5—Tower Transmission Line on Hillside.

Fig. 6—Transmission Line Over a High Bridge.

A four-part porcelain insulator, rated at 60,000 volts, is used on the entire system; these were sent out from the factory ready assembled and with a cast-iron thimble for a separable bolted pin cemented in them; they were shipped in crates of three.

The high-tension line is transposed every seven miles and the telephone every second tower or every fourth pole, an arrangement that has proven very satisfactory; the ground wire is earthed through its support at every tower and on the pole line at every fourth pole, with No. 8 copper wire stapled to the pole and soldered to a 7-ft. galvanized iron pipe driven into the ground at the butt of the pole.

At the point where the line branches off, going due west to Winona, Minn., and due south to Onalaska and La Crosse, Wis., line switches of the out-door pole-top type are installed; these are three pole, all phases opening at once, and allow the line to be opened for test or repair on each side of the "star." Line disconnecting single-pole disconnecting switches mounted on the standard line insulators, are installed outside of the Onalaska substation to permit of the line being "killed" from Onalaska to La Crosse; these are operated with a switch hook from a platform on the pole. In laying out the line provision was made for a duplicate line.

Energy is being transmitted to the cities of Winona, Minn., Onalaska, Wis., and La Crosse, Wis., there being installed at the Winona substation 2000 kw in transformers, at Onalaska 2000 kw and at La Crosse 3000 kw, and contracts are now being entered into to furnish a large amount of power to the large manufacturing establishments in the new town of Vaudreuil, Wis. This town has been founded by Eastern capitalists to take advantage of the cheap energy available; it is located practically on the transmission line and only about seven miles from the generating station.

The La Crosse Water-Power Company controls the Winona Railway & Light Company, at Winona, Minn., to whom it furnishes energy at that point; at Onalaska, Wis., it operates the substation and distribution system, but at La Crosse, Wis., the energy is delivered to the local company.

At Winona and La Crosse energy is furnished to large flour mills, the one at the former place using it at the rate of 1000 hp and the latter at 1400 hp 24 hours a day and six days a week, so that this fact, with a very heavy smaller motor load during the day and a long lighting load at night gives a very good load-factor on the generating station.

Owning as it does, thousands of acres of flowage lands, several other power and numerous other reservoir sites, the development of the system has only been well started.

In the summer of 1909 a reservoir dam was built on the main river about seven miles above the Hatfield dam, thus more than doubling the storage capacity of the system, and plans are now complete for building during this summer another storage dam, this one to be upon the East Fork of the Black River, which will back the water up for seventeen miles and have a capacity from six to seven times as large as the combined capacity of the other two ponds. The generating equipment at the Hatfield station will also be increased. Another dam, about eight miles further down the river from the Hatfield station will be erected and later the company will keep developing its other powers as the market increases. The contract for the Hatfield development was awarded to the J. G. White & Co.

COMMUTATION.

A Discussion of Resistance and Reactance of Coil Circuits During the Commutating Period.

By F. W. Carter.

THE subject of commutation has been so frequently discussed by men of eminence in the electrical engineering profession that a reader may reasonably doubt whether anything of an original nature can now be offered. The phenomenon is of considerable complexity in some of its features, although comparatively simple in its general nature, and it must be confessed that in this subject practice is in advance of theory to a greater extent than in other details of electrical design. It is hoped that the following treatment may serve to throw new light on the matter.

One of the difficulties in the scientific discussion of this subject arises from the uncertain nature of the contact between the brush and the commutator. Oscillograph records of the difference of potential between these show it to be continually varying. This is doubtless due to the agitation of the brush, and it is probable that a thin layer of air is continually present between the brush and the commutator, dragged in by the movement of the commutator, so that the current passes between them as by a very short arc. This view is confirmed by the ordinary measurements of contact resistance which really give the mean value of a very variable quantity. The impossibility of keeping the agitation quite uniform accounts for the wide discrepancy of results obtained under apparently similar conditions, but the general nature of the variation of contact resistance with current density is consistent with the above supposition. It will therefore be assumed, as being accurate enough for the present purpose, that the difference of potential between brush and commutator at any instant is a linear function of the current density—i.e., made up of a constant term depending on the direction of the current and a term proportional to the current density.

The phenomena which occur near the end of the commutation period will now be investigated, since it is here, when the contact area is vanishing, that there is possibility of great current density manifesting itself in sparking.

Consider first the simple, in fact the merely hypothetical, case in which one coil only is short-circuited at a time, as in Fig. 1. Let L be the self-induction and r the resistance of the armature coil, E the e.m.f. due to outside fields, v_1 the potential

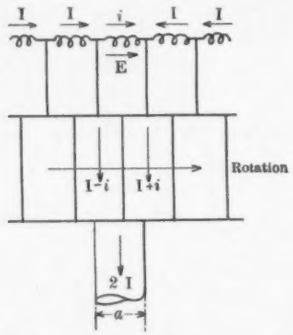


Fig. 1—Commutation with Narrow Brush.

difference between the toe segment and brush, and v_2 that between the heel segment and brush; then, t being the time,

$$E - L\frac{di}{dt} = ri + v_1 - v_2 \qquad (1)$$

Let T be the total time of short-circuit and write $t = T(1-x)$, so that xT is the interval of time to elapse before the end of commutation, xa the width of brush covered by the toe segment, and $(1-x)a$ the width covered by the heel segment. The current density under the toe of the brush is $(I+i)/xal$, and that under the heel $(I-i)/(1-x)al$, where l is the axial length of the brush.

If the potential differences between brush and segment be written,

$$v_1 = R\frac{I+i}{x} + Q,\quad v_2 = R\frac{I-i}{1-x} + Q,$$

where R and Q are functions of the time x, equation (1) becomes:

$$\frac{di}{dx} = \frac{T}{L}(-E + ri) + \frac{RT}{L}\left(\frac{I+i}{x} - \frac{I-i}{1-x}\right) \qquad (2)$$

The solution of this equation can be expressed in the form of an integral from which it can be shown that if RT/L at the end of commutation is not greater than unity the current density tends to become infinite under the toe of the brush, unless the e.m.f. of the reversing field, E, is adjusted so as to

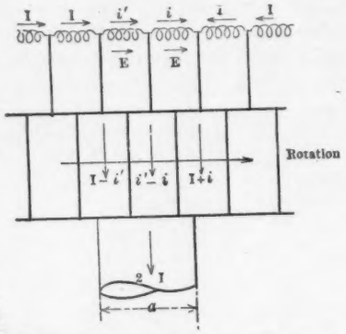


Fig. 2—Commutation with Wide Brush.

make a certain integral vanish. The system of equations corresponding to an actual case, however, cannot be thus easily solved, and it is proposed to indicate a method of treatment capable of furnishing information concerning the more general case.

It will be seen that the right-hand side of equation (2) remains finite when x becomes infinitesimal, provided that $I+i$ —assumed expressed in a series of ascending powers of x— contains no power lower than the first. If there be such a power both sides ultimately become infinite. Assume the lowest power to be x^α, so that $I+i = Ax^\alpha$ ultimately. Then equation (2) becomes ultimately

$$A\left(\alpha - \frac{RT}{L}\right)x^{\alpha-1} = \frac{T}{L}(-E - rI) - 2\frac{RT}{L}I = \text{a finite quantity.} \qquad (3)$$

Since $x^{\alpha-1}$ ultimately becomes infinite when α is less than unity, it follows that

$$\alpha - \frac{RT}{L} = 0, \text{ or } \alpha = \frac{RT}{L}$$

Hence, if $RT/L > 1$, no infinite terms can arise and the current density remains finite to the end.

Consider next the case when two coils are simultaneously short-circuited by the brush, as in Fig. 2. If M is the mutual induction of the two coils, the equations giving the currents are

$$\begin{aligned} E - L\frac{di}{dt} - M\frac{di'}{dt} &= ri + v_1 - v_2 \\ E' - M\frac{di}{dt} - L\frac{di'}{dt} &= ri' + v_2 - v_3 \end{aligned} \qquad (4)$$

If xa is the overlap on the toe segment, x_1a the width of a segment and $(1-x-x_1)a$ the overlap on the heel segment, these equations become,

$$\begin{aligned} \frac{L}{T}\frac{di}{dx} + \frac{M}{T}\frac{di'}{dx} &= ri + R\left(\frac{I+i}{x} - \frac{i'-i}{x_1}\right) - E \\ \frac{M}{T}\frac{di}{dx} + \frac{L}{T}\frac{di'}{dx} &= ri' + R\left(\frac{i'-i}{x_1} - \frac{I-i'}{1-x-x_1}\right) - E' \end{aligned} \qquad (5)$$

Arguing as before, if the ultimate value of $I+i$ is Ax^α [where $\alpha < 1$] $(I+i)/x$, di/dx and di'/dx all ultimately become infinite like $x^{\alpha-1}$. Writing $di'/dx = Bx^{\alpha-1}$ and equating to zero the coefficients of the infinite terms in equations (5)

$$\frac{L}{T}\alpha A + \frac{M}{T}B = AR$$

and (6)

$$\frac{M}{T}\alpha A + \frac{L}{T}B = 0$$

from which, eliminating A and B,

$$\left(\frac{L}{T}\alpha - R\right)\frac{L}{T} = \frac{M^2}{T^2}\alpha$$

or

$$\alpha = \frac{RT}{\frac{L^2 - M^2}{L}} \qquad (7)$$

It follows, therefore, that if RT/Λ [where $\Lambda = (L^2 - M^2)/L$] is greater than unity, infinite terms will not arise and the current density will remain finite throughout.

It may be remarked that $L - M$ is the leakage flux between consecutive armature coils due to unit current in either. Its value is greatest when the coils are in different slots, being then practically the flux between consecutive teeth due to unit current in a coil between them, or the slot inductance, as it may be called. Since L is usually large compared with $L - M$ one may write $L + M = 2L$ approximately. Thus Λ = twice the slot inductance.

The inequality takes a similar form if the coils considered, instead of being consecutive, are short-circuited by brushes of opposite polarity, as in Fig. 3, provided that the short-circuits of the two coils are not opened at the same instant. In this

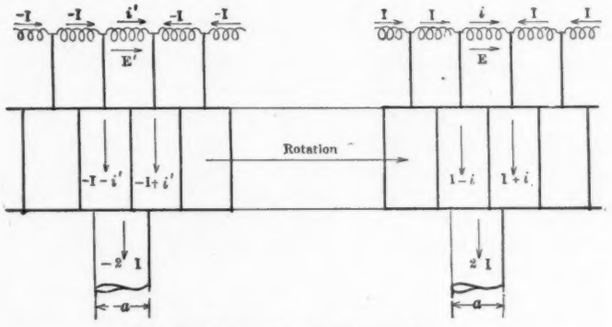


Fig. 3—Inequality in Commutation.

latter case the conditions of good commutation are more difficult to satisfy. Equations (5) become—retaining only the terms liable to become infinite—

$$\begin{aligned} \frac{L}{T}\frac{di}{dx} + \frac{M}{T}\frac{di'}{dx} &= R.\ \frac{i+I}{x} \\ \frac{M}{T}\frac{di}{dx} + \frac{L}{T}\frac{di'}{dx} &= R'.\ \frac{i'-I}{x} \end{aligned} \qquad (8)$$

where R, R' correspond to positive and negative brushes, respectively. Here all the terms become infinite in the same manner, and if $i + I = Ax^\alpha$, $i' - I = Bx^\alpha$, ultimately,

$$\begin{aligned} \left(\frac{L}{T}\alpha - R\right)A + \frac{M}{T}\alpha B &= 0 \\ \frac{M}{T}\alpha A + \left(\frac{L}{T}\alpha - R'\right)B &= 0 \end{aligned} \qquad (9)$$

and eliminating A and B

$$\left(\frac{L}{T}\alpha - R\right)\left(\frac{L}{T}\alpha - R'\right) = \frac{M^2}{T^2}\alpha^2 \qquad (10)$$

This equation for α has two positive roots. In order that the current density may not become infinite it is necessary that both roots should be greater than unity. This requires:

$$\frac{RR'T^2}{L\Lambda} + 1 > \frac{(R+R')T}{\Lambda} > 2 \qquad (11)$$

where $\Lambda = (L^2 - M^2)/L$ as before. These conditions are much less likely to be satisfied in a machine than the simpler ones derived from equation (7), indicating that the spacing of brushes an exact number of segments apart should be avoided where possible.

None of the problems above discussed is so general as the practical problem presented by an average commutating machine, in which there may be many studs of brushes, each short-circuiting two or more coils, which coils are capable of affecting one another inductively. The same methods can, nevertheless, be used in the more general case. Thus, if L_1, L_2, etc., are the self-inductions of the several coils, M_{12}, M_{13}, M_{23}, etc., their mutual inductions, i_1, i_2, etc., their currents, the equations corresponding to (5) are of the form, assuming the coil designated by 1 is just finishing commutation and retaining only the terms liable to become infinite,

$$\begin{aligned} \frac{L_1}{T}\frac{di_1}{dx} + \frac{M_{12}}{T}\frac{di_2}{dx} + \frac{M_{13}}{T}\frac{di_3}{dx} + \ldots\ldots &= R\,\frac{I+i_1}{x} \\ \frac{M_{21}}{T}\frac{di_1}{dx} + \frac{L_2}{T}\frac{di_2}{dx} + \frac{M_{23}}{T}\frac{di_3}{dx} + \ldots\ldots &= 0 \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots & \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots & \\ \frac{M_{n1}}{T}\frac{di_1}{dx} + \frac{M_{n2}}{T}\frac{di_2}{dx} + \ldots\ldots &= 0 \end{aligned} \qquad (12)$$

If $(I + i_1)/x$ becomes infinite when $x = 0$, all the quantities di_1/dx, di_2/dx, etc., become infinite in like manner. Writing

$$I + i_1 = \frac{A_1}{\alpha}x^\alpha,\ \frac{di_1}{dx} = A_1 x^{\alpha-1},\ \frac{di_2}{dx} = A_2 x^{\alpha-1}, \text{ etc.},$$

where $\alpha < 1$; the equations (12) lead to

$$\begin{aligned} \left(\frac{L_1}{T} - \frac{R}{\alpha}\right)A_1 + \frac{M_{12}}{T}A_2 + \frac{M_{13}}{T}A_3 + \ldots\ldots\frac{M_{1n}}{T}A_n &= 0 \\ \frac{M_{21}}{T}A_1 + \frac{L_2}{T}A_2 + \frac{M_{23}}{T}A_3 + \ldots\ldots\frac{M_{2n}}{T}A_n &= 0 \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots & \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots & \\ \frac{M_{n1}}{T}A_1 + \frac{M_{n2}}{T}A_2 + \frac{M_{n3}}{T}A_3 + \ldots\ldots\frac{L_n}{T}A_n &= 0 \end{aligned} \qquad (13)$$

Eliminating the A's

$$\begin{vmatrix} L_1 - \frac{RT}{\alpha} & M_{12} & M_{13} \ldots\ldots & M_{1n} \\ M_{21} & L_2 & M_{23} \ldots\ldots & M_{2n} \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & \ldots\ldots \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & \ldots\ldots \\ M_{n1} & M_{n2} & M_{n3} \ldots\ldots & L_n \end{vmatrix} = 0 \qquad (14)$$

Thus $\alpha = \frac{RT}{\Lambda}$ where

$$\Lambda = \frac{\begin{vmatrix} L_1 & M_{12} & M_{13} \ldots\ldots & M_{2n} \\ M_{21} & L_2 & M_{23} \ldots\ldots & M_{2n} \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & \ldots\ldots \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & \ldots\ldots \\ M_{n1} & M_{n2} & M_{n3} \ldots\ldots & L_n \end{vmatrix}}{\begin{vmatrix} L_2 & M_{23} & M_{24} \ldots\ldots & M_{2n} \\ M_{32} & L_3 & M_{34} \ldots\ldots & M_{3n} \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & \ldots\ldots \\ \ldots\ldots & \ldots\ldots & \ldots\ldots & \ldots\ldots \\ M_{n2} & M_{n3} & M_{n4} \ldots\ldots & L_n \end{vmatrix}} \qquad (15)$$

Hence, in order that no infinite term may arise, it is necessary that

$$\frac{RT}{\Lambda} > 1 \qquad (16)$$

where the value of Λ is given by equation (15). This is the general form of the inequality whose satisfaction is requisite to naturally sparkless commutation. The computation of Λ is not so difficult as would appear from the general expression given above. The rows in the determinants which correspond to consecutive armature coils are nearly equal, and the determinants can readily be reduced to others of fewer terms. It may be mentioned that the determinants should contain rows corresponding to field and other circuits in inductive relation with the armature coils.

Λ may be written

$$\Delta = L_1 + L_2 - 2M_{12} + \begin{vmatrix} 0 & M_{12}-L_2 & \dots & M_{1n}-M_{2n} \\ M_{21}-L_2 & L_2 & \dots & M_{2n} \\ M_{31}-M_{32} & M_{32} & \dots & M_{3n} \\ \dots & \dots & \dots & \dots \\ M_{n1}-M_{n2} & M_{n2} & \dots & L_n \end{vmatrix} \quad (17)$$

$$\begin{vmatrix} L_2 & M_{23} & M_{24} & \dots & M_{2n} \\ M_{32} & L_3 & M_{34} & \dots & M_{3n} \\ M_{42} & M_{43} & L_4 & \dots & M_{4n} \\ \dots & \dots & \dots & \dots & \dots \\ M_{n2} & M_{n3} & M_{n4} & \dots & L_n \end{vmatrix}$$

Here the greatest value of the term $(L_1 + L_2 - 2M_{12})$ is twice the slot inductance, whilst the second term is in most cases comparatively small. Thus a first approximation to A is twice the slot inductance.

The quantity R is the contact resistance of a stud of brushes at very great current density. It has already been pointed out that this is a function of the time and is thus to some extent variable. A low value should be ascribed to it, such as that deduced from slip-ring tests. It may be here observed that the provision of resistance leads between coils and commutator furnishes no assistance towards satisfying the inequality (16); such resistance is involved in quite a different manner from the brush contact resistance and in no sense constitutes an addition to R.

In the foregoing, it has been assumed that the brush is of the usual form with its toe a straight line parallel to the commutator segments, so that the area of contact on the toe segment varies as x, or the time to elapse before the end of commutation. If near the end of the commutation period, however, the area of contact on the toe segment always diminishes faster than x (say, as x^2), the tendency to an infinite current density disappears whatever the value of RT/Λ. This can be easily proven; for if the area of contact on the toe segment is equal to kx^β, where $\beta > 1$, the current density being now $(I+i)/kx^\beta$, equation (2) becomes of the form

$$\frac{di}{dx} = \frac{R_1 T}{L}\frac{I+i}{x^\beta} + \text{finite quantities.} \quad (18)$$

Now, if $I + i = Ax^\alpha$ ultimately this equation becomes

$$A\alpha x^{\alpha-1} = \frac{R_1 T}{L} A x^{\alpha-\beta} + \text{finite quantities.} \quad (19)$$

β being greater than unity it follows that it is impossible for α to be less than β, for otherwise the term $R_1 T A x^{\alpha-\beta}/L$ would ultimately become infinite compared with all other terms. This being the case the current density, i.e., $Ax^{\alpha-\beta}/k$ remains finite to the end.

Brushes whose contact surfaces have the forms shown in

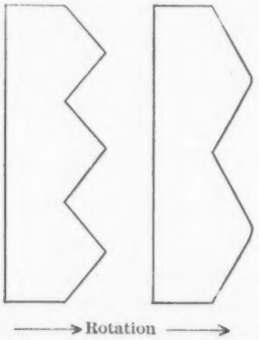
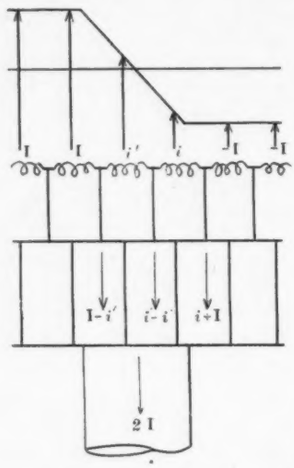
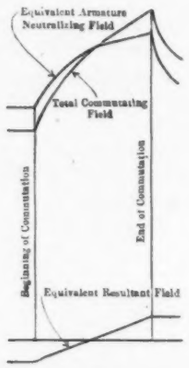


Fig. 4—Brushes with Serrated Edges.

Fig. 4, for instance, have the required property of preserving finite current density, the serrated edge being the toe of the brush. Experiment has demonstrated the correctness of the foregoing reasoning. Brushes of the ordinary form and of low contact resistance were tried on a machine of poor commutating qualities, with the expected vicious sparking at the toe. This practically disappeared on filing the toe in the manner shown in Fig. 4.

The above discussion deduces the conditions to be satisfied in order to secure what may be called natural commutation. With these satisfied, a considerable range is permissible in the commutating field. It is possible, however, to obtain sparkless commutation by adjusting the commutating field to the value which makes to vanish the coefficient of the term whose presence indicates infinite current density. When there are several coils to each slot, this can, of course, only be done





Figs. 5 and 6—Time-Values of Current and Flux.

accurately for one coil, but as the conditions of natural commutation are usually satisfied for all but the last coil in the slot, the matter is of small consequence. Even where there is only one coil per slot slight local differences in the commutator may set up sparking of continually increasing violence, so that unless the conditions of natural commutation are satisfied the commutator is likely to require frequent attention in service.

The best value to give to the commutating field will now be discussed. It is evident that the ideal mode of collection is such as makes the current density uniform over the brush surface. This requires that the current in reversing shall vary with the time according to a straight line law (Fig. 5), for only in this way is it possible for $I - i'$ to be proportional to the heel overlap $i' - i$ to be constant, and $i + I$ to be proportional to the toe overlap for all positions of the commutator with reference to the brush. Uniform current density, moreover, implies uniform potential difference between commutator and brush at any particular time—at any rate if the brush surface remains parallel to the commutator. The potential difference between commutator segments under the brush is accordingly zero.

The resultant field should produce an e.m.f. just sufficient at each instant to maintain the current in the conductor. It should, therefore, reverse in direction between the beginning and end of commutation. The commutating winding should produce a field to neutralize the armature field and in addition provide for the above resultant field.

The field due to the current in a wire-wound armature is practically constant over the commutation region, but with bar-wound machines there are eddy currents set up during reversal due to the bottom of the conductor having greater inductance than the top. In order to commutate with uniform current density in such machines it is necessary still further to increase the commutating field as commutation progresses. It is not proposed to give here the reasoning upon which this statement is based, as the mathematical analysis[1] is somewhat extensive, but the result of a calculation in a particular case is given in Fig. 6. Added to a constant field is a variation which expressed as e.m.f. amounts to some three times the Ir drop—giving a neutralizing field which for the purpose of commutation is equivalent to the armature field. To this is

[1] In this connection, see "Eddy Currents in large slot-wound conductors," by A. B. Field.—*Trans.* Amer. Inst. of Elec. Engs. Vol. xxiv, page 761.

added the field required to maintain the current—varying from $-Ir$ to $+Ir$, the resultant being the field which must be produced by the commutating winding in order to give uniform current density under the brush. The case taken is by no means an exaggerated one, and greater variation than shown in Fig. 6 is frequently required in practice.

A commutating field of the necessary form can be produced by shaping the shoes of the commutating poles as in Fig. 7.

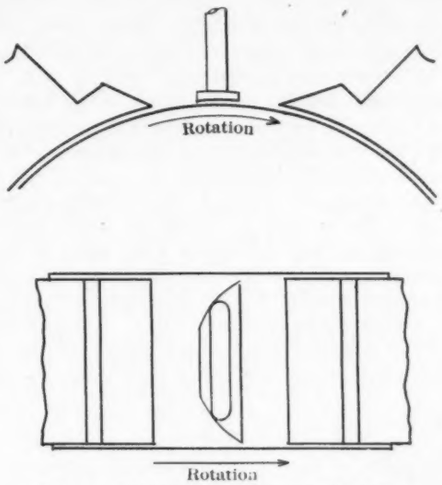


Fig. 7—Arrangement of Commutating Pole.

Sometimes, in the case of machines having distributed compensating winding, a suitable field can be produced by arranging the axis or diameter of symmetry of this winding in advance of that of the armature winding, the compensating current being increased to make up for the section of winding thus rendered inoperative for compensation. It is in the case of large continuous-current turbo-generators and machines of like difficulty in commutation that such particular adjustment of the commutating field to the needs of the machine is likely to be of sufficient advantage to repay the additional trouble of design and expense of construction.

JOINT NAVY AND FESSENDEN LONG-DISTANCE WIRELESS TESTS.

In its quest for the most efficient wireless telegraph apparatus the Navy Department is now having tests made between ships and shore stations belonging to it. While the present installations are giving very satisfactory results it has been apparent for some time that no matter how carefully tuned, communication is not certain over any considerable distance without the accompanying power behind the spark to overcome the immense amount of interference caused by the wireless apparatus on almost all seagoing vessels of any importance and through atmospheric disturbances.

Some months ago the Navy Department issued proposals for bids on high-powered transmitting and long-distance selective receiving sets, and the National Wireless Telegraph Company, builders of the Fessenden apparatus, secured this contract and is now endeavoring to fulfil the conditions prior to its bid being finally accepted.

Roughly, the scheme is to have a high-power installation at Washington, which will be a kind of master station; the mast to be an iron structural one about 600 ft. in height and the transmitting apparatus to be rated at about 50 kw. Other naval stations will also be equipped, but to a lesser extent, with sets of about 25-kw capacity, and the battleships and first-class cruisers will have 10-kw installations, all of high frequency and capable of communicating a distance of 1000 miles during either daylight or darkness. It is a well-known fact that wireless communication is many times better, possibly as much as three times, during darkness than it is in the daylight, due to the supposed actinic effect of the sun's rays on the Hertzian waves. At the present time there are stations and ships communicating regularly at night for distances of from 500 miles to 1500 miles that in the daytime could not communicate over 300 miles at the most, and for a wireless company to undertake to communicate regularly in the daytime a distance of 1000 miles is an undertaking of no small magnitude even when backed up by high-powered transmitters. If accomplished this will mean a great advancement in the art of wireless telegraphy. To accomplish this the National Wireless Telegraph Company is relying partly on the theory that with high enough frequency the effect of the sun's rays will be neutralized and communication will be the same either day or night.

In conjunction with the Navy Department the National Wireless Telegraph Company began experimenting last August, having installed on the U. S. S. *Connecticut* a high-frequency, 25-kw transmitter. But, partly from the necessity of having to install the apparatus several decks below the main deck and having no adequate means of getting full power into the antenna due to the great loss on account of induction, the tests with the *Connecticut* have for the present been abandoned and are now being carried on with 10-kw transmitters, one of which is installed on the scout cruisers *Birmingham* and *Salem* and with the 50-kw station at Brant Rock, Mass., and the Atlantic naval shore stations. These scout cruisers are admirably adapted for this work, being swift in speed and having wooden masts; the wireless station being placed in the open on the after part of the bridge, thus giving a free lead for the antenna.

During the early part of last December the installing of the apparatus on the scout cruisers was completed and the tests started, the ships steaming specified distances away from Brant Rock, and from each other, and careful data being kept on the

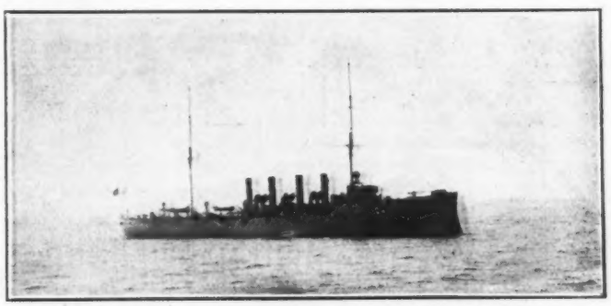


Fig. 1—U. S. S. Birmingham Equipped for Test.

amount of power necessary to keep in communication and the selective tuners calibrated to cut out interference. This test lasted for a month and was partially successful, although being rather of a preliminary nature. In the middle of January the two cruisers arrived at the Norfolk (Va.) Navy Yard to have some changes made in the apparatus and to have new topmasts fitted to increase the total height to 156 ft. from the deck and give a span to the antenna stretch of 175 ft. between the masts.

A diagram of the important connections of the 10-kw Fessenden transmitter as installed on the *Birmingham* and *Salem* is shown in Fig. 2, and a general description follows: The motor-generator set consists of a 10-kw, General Electric, 500-cycle, 110-volt, 2000-r.p.m., single-phase alternator driven by and directly connected to a 14-hp, 120-volt direct-current motor. Also directly connected on the alternator and motor shaft and on the outside end of the alternator is a synchronous rotating spark-gap consisting of a hard-rubber disk 4 ft. in diameter and 1 in. in thickness, on the periphery of which is a brass band in which set at uniform distance from each other are 30 brass spokes, there being a spoke for each field coil of the alternator. These spokes are 3½ in. in length and terminate in a small brass ball on the end. The spark-gap is completed by two stationary terminals set at equal distances and opposite each other on either side of the rotating disk, being highly insulated in porcelain and contained in a frame, which also encloses the rotating

part, and by means of a worm-gear can be turned through a small arc so as to adjust the stationary part in proper relation to the revolving part of the gap. When so adjusted a spoke comes opposite both of the stationary terminals at the exact instant maximum potential obtains in the condenser, thus producing a discharge across the gap for every alternation, or 1000 discharges per second. The heating prevalent with a high frequency is dissipated by the windage of the rotating member and the spark given off forms a high, pure musical note easily detected through even strong interference. The distance between the stationary and rotating part is from ¼ in. to ⅜ in. on either side, making a total gap of from ½ in. to ¾ in., but which, in fact, amounts to about 1 in. on account of the spark jumping a little before and hanging on after the spoke has passed the terminals.

The transformer is rated at 10 kw and has transil oil insulation. The primary voltage is the same as that of the alternator, namely, 110 volts, and from the secondary a voltage of either 25,000 or 12,500 can be obtained. There is a choke coil at each secondary terminal to guard against kicks, and in addition the transformer is protected by an adjustable safety spark-gap connected across its terminals. The current through the primary is usually constant, a spark of one intensity being used, but, when necessary, the current is regulated by varying the field strength of the alternators. The secondary is connected directly across the terminals of the rotary gap, across which in turn is also connected the main condenser in series with a variable inductance.

This condenser, for a 10-kw transmitter, is of small size, having only a total capacity of 0.09 mf. It is made in two sections, each section being separately contained in a steel cylindrical tank about 1½ ft. in diameter and 4 ft. in height suspended from an insulated wooden frame and made absolutely air tight. The condenser plates consist of steel disks 1/16 in. thick by 1 ft. in diameter. The tanks are subjected to an air pressure of 250 lb., which forms the dielectric for the condenser plates. The series of plates in each tank are connected in multiple and the two groups connected in series, the series connection being made by grounding a terminal of each condenser to the side of the tank and the tanks being metallically connected together. The other terminal is taken through heavily insulated porcelain bushings in the top of the tanks. From the two outside terminals and from the common terminal leads are taken to three copper cylinders 1 ft. in diameter which are adjustable and form a safety valve for the condenser against excessive charging.

The closed-circuit inductance connected in series with the condenser consists of 100 turns of 1/16-in. x ½-in. copper ribbon wound on a wooden cylindrical frame 18 in. in diameter and suspended on a wooden axle. Suspended on the same axle is the antennæ inductance of the same size and turns as the closed-circuit inductance and movable in relation toward or from it so that the mutual inductance and, therefore, the coupling of the two circuits, can be varied, the coupling being in all cases purely inductive. There is still another inductance made similar to the others and placed in series with the antennæ and used as a loading coil by means of which, and the inductive coupling, the wave radiated is made extremely "loose," there being practically but one wave. Each of the inductances can be revolved and by means of a wheel spring contact turns, or parts of a turn, may be obtained.

All of the connections in the secondary circuit are made with 1-in. strip copper to keep down induction and for protecting all of the space surrounding the high-tension parts of the transmitter is sheathed in copper.

The transmitting key, placed in the primary circuit of the transformer, is of the relay and series-break type, consisting of a standard telegraph key shunted by a condenser in series with an electromagnet which operates the main key in the primary.

The receiver used with this set is known as the "Fessenden I. P.," or interference-preventer type. It tunes extremely sharp, and the only objection to it is the somewhat lengthy time required to make the proper adjustments. The receiver connections are shown in Fig. 3. The antenna is led in singly to a variable inductance coil, after passing through which it divides into two branches and the two branches are brought to a common ground.

In each branch or leg is a variable condenser and a variable inductance, the primaries and two oscillation transformers. The detector circuit is inductively coupled and contains the secondaries of the two transformers and the detector, which is of the well-known Fessenden electrolytic type, and having the usual telephones and potentiometer connected in multiple around it. The fine platinum wire is adjusted by a very fine gearing which is graduated to show the depth of immersion in the electrolyte composed of a 20 per cent solution of nitric acid. Shunted around the detector is a variable condenser which acts to neutralize the effect of the inductance and a sharper coupling is therefore obtained on the transformers.

The antenna as swung on the *Birmingham* and *Salem* is of a construction somewhat radical in appearance to the usual type of antenna. It is made of standard phosphor-bronze antenna wire and the grid consists of 14 of these wires run lengthwise of the ship and at equal intervals cross-connected by 15 other wires. The lengthwise wires are spaced 3 ft. apart, and the whole is suspended on two 2½-in. iron pipes.

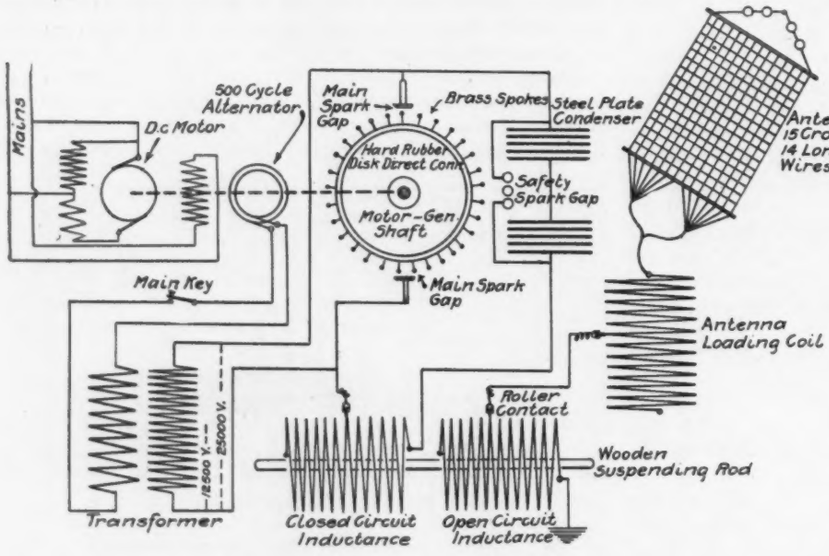


Fig. 2—Connections of 10-kw Wireless Transmitter.

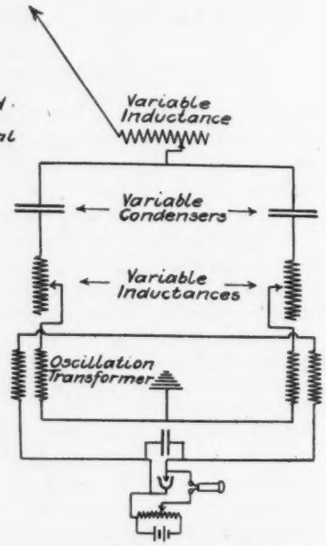


Fig. 3—Selective Receiver Connections.

The antenna is led down into the transmitting and receiving-room in the form of a loop, there being seven wires bunched to form a short fan on either side. This permits the use of either a single or looped antenna for receiving. The suspension of the whole antenna from the masts is by a hemp bridle and downhauls at both ends and Locke high-tension petticoat porcelain insulators.

Early in March the two scout cruisers left Hampton Roads, Va., with a number of expert National Wireless Telegraph Company operators on board for an extensive test, which, if successful, will mean the general introduction of high-frequency transmitters into the navy.

THE ELECTRIC STORAGE BATTERY LOCOMOTIVE.

Conclusions Based on Observations of Practical Operation in Industrial Service.

By WARREN H. MILLER, *Electrical Engineer, Standard Oil Company.*

THE general impression regarding the electric storage-battery locomotive is that it is a good thing—to avoid! If a form of trolley line cannot be arranged, we are advised by some that we had better dispense with electric traction altogether, and get along with horses or push-cars. And in most industrial plants, a trolley system is out of the question. Where it is most needed—in the shops themselves—the trolley wire is in the way of the cranes; and outside, all the overhead and steam lines interfere with it.

The prejudice against the storage-battery locomotive can be traced back to the earlier types of batteries, which after stormy and eventful careers of a very few months, went "down and out" for good; whereupon the cost sheet would be examined to show that $1,200 worth of battery had saved $25 worth of mule-power.

In the case of almost any other piece of apparatus, its positive necessities in order for it to give continued service, are usually recognized and respected. The storage-battery locomotive also has a few simple requirements, which must be accorded the same consideration, but the minute it arrives in the works, violent and two-fisted hands are laid on it, and it is put to all sorts of unheard-of abuses. It is run on tracks that would hardly be safe for a mountain goat, and the batteries' needs for a reasonable amount of charging, an occasional replacing of evaporated water, and a little supervision of the gravity of the acid, utterly ignored. Another prolific source of failure of storage-battery locomotives is incorrect proportioning of battery and motors to the service expected, and to this might be added the lack of the right charging facilities.

To the average industrial engineer, unaccustomed to these specialties, the operation of the battery at various discharge rates, the characteristics of the motors, and the requirements of the battery, are more or less hazy—while he is selecting the equipment. Afterward, he learns exactly what he wants, and can tell the management precisely the trouble, but the equipment has already been bought, and it is a burdensome job getting any more money until the first installation shows "profits."

One might think that the manufacturers themselves would be the ones on whom to rely for proper selection of equipment for a given service, but none of them seem to have built more than a few sizes for special services, and their proposals are sometimes absolutely wild—specifying locomotives all the way from 2.5 to 10 tons and motors from 4 hp to 20 hp, for the same service requirements. The company which finally won in a recent competition, revised its own figures four times without arriving at any reasonable proportions between motor, battery and locomotive, and it finally ended by having the customer specify every detail of the locomotive and hold a second competition on this specification, allowing no deviation. This locomotive, after a year's service, still stands well up to the work, and does considerably better than contract requirements.

The writer would emphasize that the storage-battery industrial locomotive is not only a good thing to have, but it is surprising that the industrial plants of the country do not count them as equipment quite as essential as their electric cranes. Storage-battery locomotives can go anywhere that track can be laid, can pull train loads of 15 to 50 tons, cost but little to maintain and charge, and are worth many times their cost in any large plant where big quantities of stock and partly finished product have to be moved from one part of the works to another.

It is the purpose of this article to give some data on the subject of the electric storage-battery locomotives; first on the selection of proper equipment, next on the care of battery and locomotive, and finally on the facilities for charging.

SIZE OF LOCOMOTIVE.

Some manufacturers give tables of the weights in tons which the various sizes of their locomotives will haul on different grades and with different draw-bar friction loads in pounds per ton hauled. A deal of judgment is required to use these tables with discernment, because, of course, the tonnage a locomotive will haul depends first of all on the condition of the track and the quality of the cars. For instance, a certain manufacturer's table gives 60 tons as the weight a 6-ton locomotive will haul on the worst of three friction loads, namely 40 lb. per ton, draw-bar pull. For a 30-lb. draw-bar pull 80 tons is given, and for 20 lb. per ton, 120 tons. Possibly these figures are correct with ball-bearing cars and a plane-table track. In actual service a 6-ton locomotive does well to haul 20 tons without slipping the wheels on track of the 36-in. gage, 30-lb. rail industrial type, and handling ordinary Wonham-Magor steel-dump cars, loaded with ashes, coke or gravel.

In other words, it is better not to assume any of the draw-bar coefficients, high as they are, compared to railroad practice (7½ lb. per ton), unless one can count on a first-class permanent roadbed with rails laid in concrete and kept clean. When the rails are to go all over the yard, on ties put down and leveled by the yard gang, it is not advisable to use a locomotive much lighter than 10 tons to haul 60 tons. If the same track contains curves and grades of from 1 to 2 per cent, about 40 tons is the most one may expect a 10-ton locomotive to haul. It may be well to mention here that good and careful laying of tracks, and ample curves and turnouts and switches pay well in the saving of energy with storage-battery locomotives. A 6-ton locomotive, taking about 70 amp on the ordinary straight track, will draw up to 200 amp when going around a curve of 25-ft. radius, whereas, if a 40-ft. radius were chosen the current would not rise much above 100 amp. In the majority of curves and corners, curves of 40-ft. radius are quite as easy to lay as smaller ones and result in a saving of 100 per cent of the current. This effect continues not only for the few minutes of going around the curve, but shows up later; for several 25-ft. curves in succession will use enough energy from the battery to lower its e.m.f. by several volts. It will then be some time before the battery recovers, and meanwhile a higher amperage must be used for the motors.

For pure intershop service, the small 2.5-ton locomotive or truck answers very nicely and will haul about 10 tons, as the track is laid on level wooden or concrete shop floors, though the average load is more likely to be two or three tons. For yard service, hauling ashes, ingots, castings, etc., the 10-ton and 6-ton sizes are best, as they carry a battery rated at 250 to 500 amp.-hours, and can work all day with only a supplemental charging at the noon hour.

SELECTION OF MOTORS.

Having determined the size of the locomotive, the next consideration will be the motors. In most designs two are employed and the wheels are inside-hung, using M.C.B. journal boxes, which are easily packed and repaired. The size of these motors should receive a good deal of consideration, as one cannot get much more than a 250-amp. battery on a 6-ton locomotive without overrunning the total weight, and, if the motors are too large, they will waste half the energy in the controller resistance. The term "horsepower" is a very illu-

sive quantity with these motors. They are series-wound, so that the heavier the load the slower they go. A glance at the curves in Fig. 1 will give an idea of the variation of the horsepower of any single size of motor with the speed and amperage. These curves show the electrical and speed characteristics of a 110-volt motor, rated at 20 hp for one-half hour, with 40° C. temperature rise by thermometer.

To select the proper motor equipment one should first make up a chart of the daily service expected of the locomotive. Assume, for example, that this service figures 16 tons, includ-

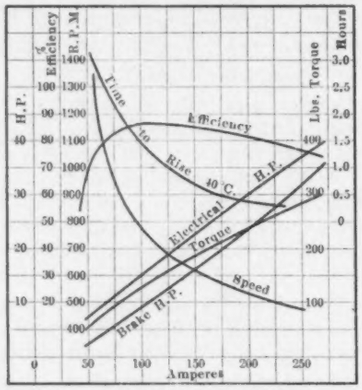


Fig. 1—Electrical and Speed Characteristics of 20-HP Motor.

ing the weight of the locomotive, hauled 18 miles during the day, or 288 ton-miles. There is, of course, no use in getting the motors any larger than will slip the wheels of the 6-ton locomotive selected for this service. The draw-bar pull may be taken as one-fifth of the weight of the locomotive, or 2400 lb. The mean speed of the locomotive will be five miles per hour, or 440 feet per minute, thus requiring 31 hp as the gross output of the motors at maximum pull. This service would call for two 15-hp motors, but they would be a good deal too large for the 250 amp.-hour battery and would run away with all ordinary service loads. Moreover, the average service requires only 16 tons to be hauled at five miles per hour, which at 40 lbs. draw-bar pull per ton, is 640 lb. adhesion, or equiv-

alent to $\frac{640 \times 440}{33{,}000} = 8\frac{1}{2}$ hp. The nearest motor size to this is $7\frac{1}{2}$ hp, so that the logical procedure would be to have two $7\frac{1}{2}$-hp motors, one on each axle, with knife switches to throw in one, or both, when on heavy grades or bad curves calling for the full power supply. A scrutiny of the characteristic curves for this size of motor shows that when taking twice the normal current, or the equivalent of 30 hp, the speed will drop one-third, so that the actual horsepower of the two motors together will not exceed twenty horsepower. The time for the temperature to rise 40° C. will be reduced to about seven minutes, but the actual time in passing over such points should not consume more than 1.5 minutes. As a matter of fact, it works out in practice that two $7\frac{1}{2}$-hp motors will use up the battery energy in about eight hours' yard work, or ten hours with an extra charging at the noon hour. A single motor is used when hauling empty cars and two motors when hauling full cars, because curves and light 1-per cent grades are quite frequent, and at least once an hour heavy grades and short curves have to be negotiated with full loads. The temperature rise of the motors never exceeds 30° C. throughout the day, and brushes and commutators keep in very good shape.

The next consideration would be the size and make of the storage battery. The battery itself was the principal source of trouble with the earlier designs of industrial locomotives. The plates used were of the grid type, having pockets filled with active material, which promptly fell out and short-circuited the cell. There was also seldom any correct proportion observed in applying the battery to its motors, so that it had to be overdriven and overcharged continuously to get even a full day's work out of it.

In the modern locomotive storage batteries the use of the pocket types of grids is abandoned in favor of machined plates. In these a large surface is obtained either by turning up a series of rough ridges like the surface of a coarse file, or by making the element out of narrow strips of lead combined in a fine grillage consisting of hundreds of these strips. These plates are then "formed" by slow electric processes of continued charging and discharging, and the oxides are thus very tough and difficult to dislodge from the metal. Even at that, the locomotive gets so much jolting over crossings, switches and bad sections of track that after about six months' service the mud-cellars of the battery cells have become filled up with sediment and short-circuit the plates.

SIZE OF BATTERIES.

An inspection of the discharge rates in Table I shows the 5-hour discharge rate for a 250-amp-hour battery to be 50 amp on 100 volts, representing about 6 hp. The average running current is from 35 to 70 amp in a 6-ton locomotive hauling

TABLE I.—RATINGS OF ELECTRIC-LOCOMOTIVE STORAGE BATTERIES.

	Discharge rate for.				Amp-hour capacity				Charge rate.	
Size.	8 hrs.	5 hrs.	3 hrs.	1 hr.	8 hrs.	5 hrs.	3 hrs.	1 hr.	Nor.	Max.
3-R2	5	7	10	20	40	35	30	20	5	10
5-R2	10	14	20	40	80	70	60	40	10	20
7-R2	15	21	30	60	120	105	90	60	15	30
9-R2	20	28	40	80	160	140	120	80	20	40
11-R2	25	35	50	100	200	175	150	100	25	50
13-R2	30	42	60	120	240	210	180	120	30	60
15-R2	35	49	75	140	280	245	210	140	35	70
17-R2	40	56	80	160	320	280	240	160	40	80
5-R3	12	16.8	24	48	96	84	72	48	12	24
7-R3	18	25.2	36	72	144	126	108	72	18	36
9-R3	24	33.6	48	96	192	168	144	96	24	48
11-R3	30	42	60	120	240	210	180	120	30	60
13-R3	36	50.4	72	144	288	252	216	144	36	72
15-R3	42	58.8	84	168	336	294	252	168	42	84
17-R3	48	67.2	96	192	384	336	288	192	48	96

five dump cars about the yard. Such a battery will supply energy for about $7\frac{1}{2}$ hours before the e.m.f. drops to 89 volts, as, of course, half of the running time is with empty cars. The battery consists of 48 cells, arranged in twelve strong oak boxes with porcelain rollers and iron handles, six on each side of the locomotive. Four iron shutters, two on a side, enclose the boxes, and, by lifting these, the boxes can be rolled out onto a platform for inspection or cleaning. The four cells in each box are enclosed in hard-rubber jars and the interstices between the cells and the sides of the wooden boxes are poured solid with melted paraffine wax to prevent jarring or rubbing

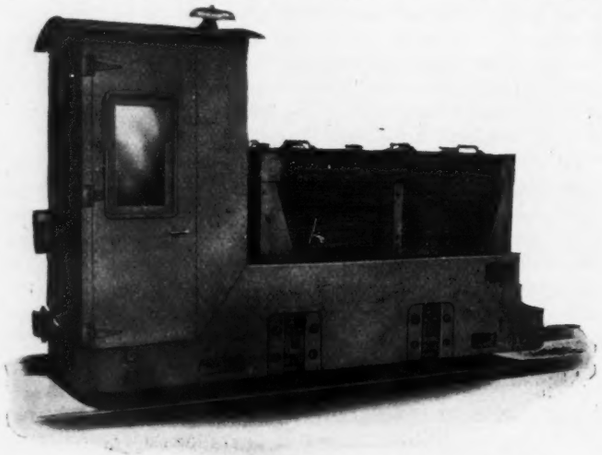


Fig. 2—Storage Battery Industrial Locomotive.

while the locomotive is running. The four cells in the box are permanently connected by ½-in. round, lead connectors, each box being connected to the adjacent ones by heavy flexible leads fastened with wing-nuts. Within the cell jars each group of elements is soldered to a heavy lead master-bar, and between adjacent plates are inserted hard-rubber perforated separators and thin sheets of hard maple, the latter preventing mechanical transfer of the material during gassing, although not interfering with the chemical processes. Each jar is closed by a splash cover and a hard-rubber seal.

The solution employed is chemically pure sulphuric acid (specific gravity, 1.84) and distilled water, the two being mixed to a specific gravity of 1.225. This electrolyte introduced another trouble with storage batteries. No distilled water was to be had without going to some trouble to make or buy it, and so the ordinary boiler-feed water or drinking water of the works, full of iron and carbonates, was used. As the battery evaporates one-fourth of its water every fifteen days, only a very few months elapsed before the iron and carbonate impurities on the plates rendered them totally inactive.

The batteries are shipped dry, except the maple sheets, which are soaked in wet sawdust. After unpacking, assembling and putting in the electrolyte, mixed to a specific gravity of 1.200, the cell first needs a 72-hour charge. The maximum charging e.m.f. is 2.8 volts per cell, so that for 48 cells 135 volts will be required. The battery will charge along nicely at about 104 volts, gradually increasing to 118, when its e.m.f. suddenly rises to 135 volts, and should then be charged for an hour at this rate, gassing freely. Meanwhile the specific gravity has been slowly rising and should be up nearly to 1.225. Enough electrolyte is then added to fill up one inch above the tops of the plates and bring the specific gravity up to 1.225. The battery is then ready for service. It will supply energy to the motors at about 104 volts at first, but during the day the voltage gradually drops until it reaches 90, indicating that the battery is nearly exhausted. The locomotives should be at once taken

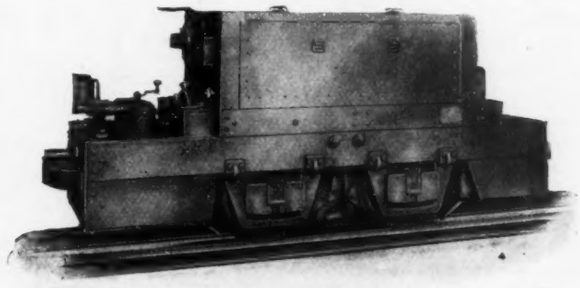


Fig. 3—Storage Battery Industrial Locomotive.

back to the charging station, no matter what work is yet to be done. This rule should be inexorable in the works, or it will be ignored, as there is always "just one more trip" to be made, and this trip is always "important." So is the locomotive—for the next day's work. Such overdischarge will surely buckle the plates and sulphate the active material if attempt is made to operate the 48-cell battery below 89 volts.

When it arrives at the power house or other charging station the locomotive should be at once put on charge. The table shows that 36 amp is the normal charging rate, so the voltage should be set by rheostat or by field regulation of the dynamo, to give the battery this current, which it will do at about 104 volts. A sample record of charging is reproduced in Table II. The battery need hardly be touched for the next three hours, but by this time the current will be found to have fallen off, and the voltage must be raised to bring it up to 36 amp again. From then on for the next four hours the voltage must be raised at least once every hour, during which time it will have crept up to 118 volts. It then jumps to the

TABLE II.—CHARGING RECORD OF ELECTRIC LOCOMOTIVE.

Amps.	Volts.	Specific Gravity.	Time.
50	103	.....	9.30 P. M.
50	107	1.150	10.00 "
50	112	1.175	11.00 "
50	115	1.180	12.00 M'dn't.
50	118	1.185	1.00 A. M.
50	123	1.200	2.00 "
50	135	1.240	3.00 "
50	137	1.255	4.00 "
50	137	1.255	5.00 "

maximum of 135 volts and is virtually fully charged and gassing freely. After an hour of this the charging current can then be shut off and the locomotive will be ready to go out on the job the following morning.

This régime will be kept up nicely until about the fifteenth day, about which time the locomotive will be reported as "falling off in her work." An inspection of the battery will probably reveal that where formerly there was an inch of electrolyte above the plates the level is now about two inches below, representing loss by evaporation and decomposition of the water into hydrogen and oxygen. The specific gravity will also have risen, as none of the sulphuric acid got away; and, altogether, it will be a morning's work for three or four men to take out and re-adjust all the electrolyte back to a specific gravity of 1.225, using distilled water. If the electrolyte does not come up to this specific gravity, it should be put back just the same and given extra charges of two or three hours for several nights thereafter. If the electrolyte still lacks the required strength, sulphuric acid should be added, but not until then. The battery man should recognize the replacing of the evaporation as part of the regular routine of the electric locomotive service, and set aside the mornings of the first and fifteenth of the month for re-adjusting the specific gravity and filling the cells up to the proper level above the plates.

Under such regulations as the above and with a vigilant outlook for such minor defects as broken porcelain rollers, acid-eaten connectors, paraffine seeping through the pores of the wooden boxes, etc., the locomotive will give steady and reliable service for about six months. Then there will come a time when the specific gravity of the electrolyte is all right and everything is apparently in good shape, and yet the locomotive will not operate, and no amount of charging or gassing will cause it to do so. The trouble is that during the six months of running little particles of lead oxide have gradually accumulated in the mud cellar in the bottom of the cells until the sediment reaches the bottom of the plates, thereby short-circuiting them. The cell voltmeter will show this fact instantly, some of the boxes reading their normal 8 volts and others only 2 or 3 volts. It is best not to attempt to correct these, but to arrange at once for a four days' "leave of absence off duty" for the locomotive and let the electricians get at it for a complete cleaning of all 48 cells. The lead connectors should be cut apart at the connecting buttons, using the tool sent for that purpose, and the elements lifted out of the cells. In each jar will be found a quantity of lead-oxide sediment, which must be taken out and the jars cleaned. The separators will be found to be caked full of sediment, and both they and the elements should be thoroughly washed in plain fresh water. The maple sheets will go to pieces, and new ones should be taken from the spare-part stock. The elements are then to be replaced and connectors "burnt" together with the set of lead-burning tools which should be furnished with the locomotive. It will be found that there is only enough of the old electrolyte to fill about one-third of the cells, so that the rest must be new acid and distilled water. About three carboys of chemically pure sulphuric acid, of 1.84 specific gravity, will answer to refill the battery of a 6-ton locomotive.

During these four days the motors, brakes, gears, battery boxes, controller fingers, sanders, journal boxes, etc., should have a thorough overhauling and replacement of worn-out parts, and the locomotive will then be ready for another six months, good as new in every respect. Of course, a complete stock of repair parts for batteries, locomotive and motors should be kept on hand, with an extra allowance of brake-shoes and porcelain rollers. About one set of the former wear out every three months, and the latter cannot be cast in iron because of the immunity the porcelain rollers give from loss of power by creeping currents.

To get more service out of the locomotives the writer has tried the plan of having two sets of batteries and a transfer shed, so that the spent set can be hauled out on the platform and the new ones rolled in during the noon hour.

CHARGING FACILITIES.

A slate panel, with ammeter, 150-volt voltmeter, 20-volt voltmeter, double-throw switch, and charging rheostat, will suffice to charge two locomotives at the same time. The energy is

obtained from the spare powerhouse exciter—whichever one is not in use on the generators—because this machine must go to a maximum of 135 volts, which would not be permissible for generator excitation. One locomotive can be charged directly from this and the other can be regulated by the rheostat in series with it, regardless of the other, provided that both of them approach a maximum at reasonably the same time. When the large generators for the works supply direct current at 125 volts, probably a small booster in series with the line would answer, or else a 40-cell battery should be specified. If the local power house pressure is 220 volts, a 200-volt battery should be selected.

In conclusion, it may be pointed out that all locomotives, both steam and electric, for contract service, are always rough-and-ready pieces of apparatus, needing considerable repair, and while, therefore, motor cradles will occasionally be cracked, journal-box covers torn off, sander tubes bent and mashed, and battery plates buckled once in a while, the repairs are, on the whole, less than those to mule power. On the other hand, in saving operating expense, the locomotive is far in the lead, saving the upkeep of a dozen mules and their drivers, while its own expenses are only the wages of a driver and switchman, plus the cost of 30 kw-hours per day. The cost of a 6-ton locomotive is about $2,800, and that of an extra battery $1,250. The order for such an equipment would read about as follows: One electric storage-battery locomotive, weight, 6 tons; maximum drawbar pull, 2250 lb.; storage battery, 110 volts, 300 amp-hours' capacity; two 7½-hp series motors, arranged to be used separately or together; maximum height to top of cab, 5 ft. 6 in.; maximum width, 5 ft. 3 in.; gage of track, 36 in.; locomotive to be complete with cab, inside-hung wheels, brakes, circuit-breakers, tools, headlights, and bell, and guaranteed to perform all services as set forth in our specification on one charge of battery, with one hour's charge at noon.

The cost of the 2½-ton size would be about $2,000. A locomotive with the batteries sunk below the deck, making the top a flat shop truck, would cost about $1,800.

Central Station

Management, Policies and Commercial Methods

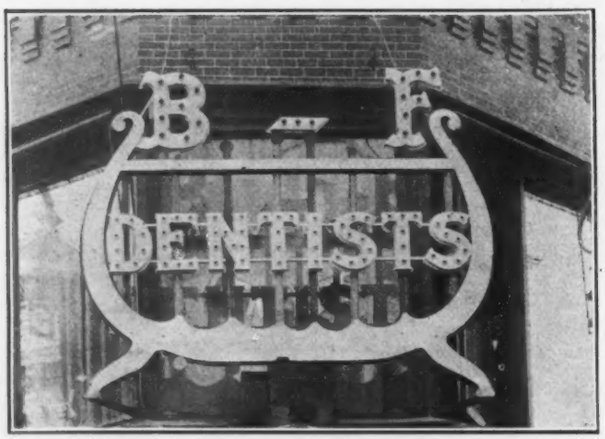
RESTRICTIONS FOR GASOLINE LIGHTING.

In the Rocky Mountain region, a number of towns and cities are considering gasoline lighting ordinances. The State law provides that gasoline shall be in outside buried tanks when used in connection with lighting systems, and the municipal restrictions follow this statute.

Laramie, Wyo., has two ordinances now before its Council restricting electric wiring and gasoline lighting installations. The National Electrical Code and grounded secondaries are the basis of the electrical ordinance. Outside buried tanks for gasoline, and outside carbureters are the basis of the gasoline lighting ordinance. Both ordinances grew out of bad lighting conditions with unnecessary fire hazards, causing higher insurance rates to be applied.

SINGING SIGN IN DENVER.

Denver has been noted for its progressiveness in the matter of electric signs, due to the active work of the new business department of the Denver Gas & Electric Company. Mr. G. E. Williamson is in charge of that branch of the work and his latest product is a singing sign for which he recently secured an order from a firm of dentists at Sixteenth and Curtis Streets. This particular customer wanted a sign which would attract attention by sound during the day as well as by flashing at night.



Musical Electric Sign.

The sign is in the shape of a lyre having eight strings. On each string is a letter. The sign spells the word "Dentists." The eight strings correspond, of course, to the eight notes of the octave and suggested the idea of striking the successive notes of an octave as the letters are successively flashed on. The letters are flashed one at a time by the use of a Dull flasher, and as the letters are flashed on, the musical scale is played by the use of wooden hammers which strike orchestra bells one by one, beginning with the lowest note of the octave and going up in regular succession. The flasher wheels make the usual contacts for each letter. In addition to this the wheels have lugs which are adjusted to pull down the hammers at the proper time when the wheels revolve. A hammer slips off a lug just as each letter flashes and produces a note simultaneously with the flashing of the letter until the complete scale has been played and the complete word "Dentists" has been spelled out.

While this particular sign is quite simple, as it repeats the notes of the octave only, it is possible to work out almost any combination of tones by different flasher combinations. The sign is 11 ft. long and 7 ft. high, covered with gold leaf on the frame and silver bronze on the strings. The effect is novel and evidently presents another possibility in the way of electrical advertising. The sign was built by the Ellis Sign Company of Denver, under Mr. Williamson's specifications.

MOTOR DRIVE AND FACTORY LOCATION.

One of the strong arguments by which the central-station company appeals to the manufacturer and factory owner in setting forth the advantages of supplanting isolated power plants with motor-drive, is the possibility of locating factory sites in sections favored by low ground cost, pleasing surroundings, and good transportation facilities. Central-station electric service renders the shop owner independent of the usual ugly and unpleasant manufacturing districts of the city, and of all power-plant considerations involving coal storage and ash disposal. Nor is the user of the motor drive required to lease an undesirable building "with power" away from the districts convenient for business and transportation. Instead, he may build or install his factory in a well-selected outlying portion of town where rent or ground cost is low, and where the surroundings are bright, pleasant and healthful for manufacturer and employee.

These arguments are well presented in the accompanying

advertisement published by the Commonwealth Edison Company, of Chicago, in the local newspapers of March 22, as part of the new-business campaign that company has undertaken to increase its industrial motor load. The picture of the manufacturer, with his stackless factory building and his electric motor under his arm, forsaking the smoky, dark and dirty industrial section, to set up operation in a more desirable locality, tells its own story of the advantages of central-station energy for motor drive.

Be Independent in Selecting Your Factory Location
It is no longer necessary for the manufacturer to select his factory location with regard to space for power plant—storage of coal and disposal of ashes. No longer need the small manufacturer be tied to an old, dingy, poorly located building just because it supplies power to its tenants.
Use Central Station Power
With electric motors, operated by current from Central Station, the factory may be located at a point convenient to the labor market, or to transportation facilities, and where abundant light and healthful surroundings predominate. Wherever the factory or the small user of power be located, current may be had from the mains of
Commonwealth Edison Co.
Telephone Randolph 1280—139 Adams Street

Commonwealth Edison Newspaper Advertisement.

PRIZES FOR PAPERS ON THE CENTRAL-STATION RATE PROBLEM.

The Central-Station Development Company, Cleveland, Ohio, has organized a competition for prizes to be awarded for 21 papers offering the best solutions to the central-station rate problem. Twenty-one prizes will be given, aggregating $1,500, as follows: One prize, $500; two prizes, $250 each; three prizes, $100 each; five prizes, $20 each; ten prizes, $10 each. The papers are required to be based on a paper by Mr. S. E. Doane, chief engineer of the National Electric Lamp Association, entitled "The Cost of Light," and read at the convention of the Canadian Electrical Light Association last year, copies of which will be supplied to those signifying their intention of entering the competition.

Mr. Doane's paper establishes the principle that profits should be made upon the fixed charges as well as upon the kw-hour charge, and that the latter should be so low that the loss of revenue due to the replacement of carbon filament by high-efficiency lamps will not diminish the returns to the station beyond the decrease in station cost. He furthermore shows, first, that with such a rate a central station could handle its present customers with only a portion of its equipment, and that consequently it would be able to take on many more customers before the station again became loaded; and second, that a change, on the part of the majority of a station's customers to lamps of an efficiency higher than that of carbon would not cause the station to lose money. This change would not occur in one day, but would be the growth of some little time. The total change would be a repetition of the following evolution: A few of the customers changing to the higher efficiency lamps would release part of the generating capacity of the station, thus enabling the station to add a few more customers. These new customers would come on the circuits at a very large profit to the station, inasmuch as the old customers were paying one component of the fixed charges so that when enough customers had been taken on the central station could decrease the fixed charges to all. The reduced rates would further stimulate the use of electric lighting, and would make the taking of new customers more easy. With continued increase of patronage there could be another reduction in rates, and so on until the station was again fully loaded, at which time electric light would be furnished to the public at a much lower rate than originally. Yet from the very day of adoption of the new rates, the central station would not only be without loss of profits, but the rates would be such that the station would immediately begin to increase its profits, while at the same time the cost to the consumer would be reduced. The kw-hour charge by this system would be a very low one, and would greatly stimulate the use of cooking utensils, fans and other day uses for energy so that the general effect would greatly improve the load factor.

The Central-Station Development Company wishes to receive from central-station men as many clearly written, comprehensive explanations, suggestions, illustrations, or treatises on this subject as possible. In order that an article may receive prize consideration, the plan program, or system of rates, must cover comprehensively every application of central-station activity which might be embodied in that particular system. The rate system suggested or discussed should be completely worked out to cover the use of lighting equipment, motors, rectifiers, and all sorts of regular or special service.

Only those directly connected as employees, or in charge of central stations and municipal plants, will be considered eligible to compete for the prizes. The awards will be based upon the thoroughness of treatment of individual and special conditions, as well as on their general applicability to central-station requirements. All solutions must be submitted by or before June 15, 1910.

A committee composed of five of the leading central-station men of the country, whose names will be made public on June 1, will pass upon the solutions submitted to determine who shall be entitled to the different awards. These awards will be paid on the recommendations of a majority of the committee one week after the announcement by the committee of the successful contestants.

COST OF PRODUCTION IN FOUR CENTRAL STATIONS.

Detailed records of the cost of producing electricity in central stations under a common management often illustrate the predominating influence of local conditions upon the expense of generation. Expectations of an immediate standardization of manufacturing costs upon the assumption of centralized control of properties cannot, as a rule, be realized until the administration of progressive enginering and commercial policies can be applied in local fields. In this connection the following results of operation are of interest, covering the manufacturing cost, exclusive of fixed charges, for the year ending June 30, 1909, in four properties now under the Tenney managing interests located in Massachusetts. The figures are derived from the usual returns of the companies to the commonwealth, the properties being the Salem Electric Lighting Company, the Fitchburg Gas & Electric Light Company, the Haverhill Electric Company and the Malden Electric Company.

PRODUCTION CONDITIONS AT SALEM.

The Salem property is one of the latest additions to the Tenney group, and the station equipment has been undergoing something of a transition in recent years. The company serves one of the most noted residential communities in the East, less industrial in character than those at Fitchburg and Haverhill, but with a growing motor load in certain specialized lines. The equipment of the generating station on June 30 last consisted of a boiler plant rated at 2750 hp and an electric generating installation of 3535 hp engine rating. All but four of the boilers

are equipped with shaking grates. The engine equipments consist of machines of the cross-compound condensing type and drive mainly by direct connection four 2300-volt, three-phase alternators rated at 1000 kw, 600 kw, 400 kw and 200 kw, and two 500-volt, direct-current generators rated at 200 kw and 100 kw. The alternating-current and direct-current sides of the station are inter-connected by a 200-kw synchronous motor-generator set consisting of a 500-volt dynamo driven by a 2300-volt motor.

The cost of manufacture per kw-hour delivered at the switchboard was 1.41 cents. The station payroll covered the services

COST OF OPERATION, SALEM, 1909.

Kw-hours delivered at switchboard during year	3,106,142
Coal	$23,080.44
Oil and waste	799.52
Water	840.04
Station wages	12,842.50
Station building repairs	1,049.94
Steam equipment repairs	4,926.61
Electrical equipment repairs	332.80
Total	$43,871.65

of 14 men, including four engineers, three firemen, two engine cleaners, three switchboard men and two coal passers. The fuel consumption for the year was 5118 tons of Cumberland coal, costing the company an average price of $4.51 per ton. The maximum load upon the plant was 1245 kw, occurring in December, 1908. The total energy sales were 2,628,908 kw-hours, of which 731,113 kw-hours were for motor application.

PRODUCTION CONDITIONS AT FITCHBURG.

The power plant of the Fitchburg Gas & Electric Light Company is a direct-connected engine-driven installation, with modern boilers and a design free from complications. The steam generating plant consists of five 250-hp. Stirling boilers operating at 150 lb. pressure. The generating equipment of the station comprises three engines, which drive 400-kw, 600-kw and 1000-kw, direct-connected alternators, delivering 2300-volt, 60-cycle current at the switchboard. The engines are of the vertical, cross-compound condensing type, and the boilers are fired by hand.

Here the cost of manufacture per kw-hour was 1.24 cents. The company used coal and coke in its furnaces, the former

COST OF OPERATION, FITCHBURG, 1909.

Kw-hours delivered at the switchboard during year	4,006,157
Coal and coke	$29,672.89
Oil and waste	593.06
Water	1,018.72
Wages at station	12,105.42
Repairs, building	691.66
Repairs, steam equipment	1,651.51
Repairs, electrical equipment	2,905.18
Tools and small appliances	49.90
Miscellaneous	928.43
Total	$49,616.77

costing $4.885 per ton and the latter $4.07. About 3700 tons of coal and 2852 tons of coke were used. The station labor requirements were twelve men, consisting of four engineers, three oilers, three firemen and two helpers.

A feature of the Fitchburg situation is the prominence of the motor load. The total sales for the year were 3,788,537 kw-hours, of which 2,316,561 kw-hours were sold for motor service.

PRODUCTION CONDITIONS AT HAVERHILL.

The Haverhill Electric Company operates a mixed equipment of engine and turbine-driven generators, with modern boilers and full condensing facilities. The steam generating list contains seven boilers with an aggregate rating of 2250 hp, two of which are equipped with stokers.

The steam-electric equipment consists of one cross-compound condensing engine, belted to a 300-kw alternator, and two 1000-kw horizontal turbo-alternators.

The average cost of manufacture per kw-hour was 1.15 cents. The operation of the station required the services of thirteen men, including four engineers, three firemen, two oilers, two coal passers and two switchboard men. The total fuel con-

COST OF OPERATION, HAVERHILL, 1909.

Kw-hours delivered at switchboard during year	3,721,153
Fuel	$24,127.00
Oil and waste	708.57
Water	100.32
Wages at station	10,633.87
Building repairs	2,382.95
Steam equipment repairs	2,748.88
Electrical equipment repairs	693.24
Miscellaneous	1,499.94
Total	$42,894.77

sumption for the year was 6076 tons, the average cost per ton being $3.97. The total energy sales for the year were 2,867,710 kw-hours, and the motor load totaled 1,702,929 kw-hours.

PRODUCTION CONDITIONS AT MALDEN.

The power plant of the Malden Electric Company also illustrates the tendency of many moderate sized plants to depart from the reciprocating engine installation and adopt the steam turbine for new work. The boiler plant here consists of four units, there being one 650-hp and three 420-hp water tube equipments operated at about 160 lbs. steam pressure. The electric generating equipment contains three compound engines and one 1500-kw horizontal turbine. In addition the company listed the following generators for the year: One 250-kw, one 400-kw and two 750-kw units. A cooling tower installation is in operation in this station.

The cost of production per kw-hour was 1.08 cents, and the company burned 6033 tons of Cumberland coal and about 1057

OPERATING COST AT MALDEN, 1909.

Kw-hours delivered at station switchboard during year	4,715,460
Fuel	$26,779.33
Oil and waste	939.66
Water	2,118.68
Wages at Station	14,812.98
Building repairs	1,086.86
Steam equipment repairs	3,457.13
Electrical equipment repairs	691.74
Tools, etc.	973.50
Total	$50,859.88

tons of coke breeze during the year, the cost of the former being approximately $4.08 and the latter $1.75 per ton. The station labor requirements were five engineers, two oilers, two steam-fitters, three firemen and two switchboard men, total fourteen men. Stokers are used in the boiler room. The maximum load in the year was 1650 kw, in December, 1908, and the total sales were 3,549,659 kw-hours, of which motor service called for 881,109 kw-hours.

COST OF PRODUCTION IN FOUR CENTRAL-STATIONS.

In the following table are given the fuel, labor, miscellaneous and total manufacturing costs of producing electricity in the above plants per kw-hour, for the year covered:

UNIT COST OF PRODUCTION, FOUR PLANTS, 1909.

	Salem.	Fitchburg.	Haverhill.	Malden.
Fuel	0.74	0.74	0.65	0.57
Labor	0.41	0.30	0.28	0.31
Miscellaneous	0.26	0.20	0.22	0.20
Total, cents	1.41	1.24	1.15	1.08

All items except fuel and labor are covered in the miscellaneous item above named. In none of the plants reviewed are any fixed charges included. The figures are printed as specific examples of the bearing of initial fuel cost per ton and general station design upon economy of production. It is probable that as time passes the costs will be brought into still closer relation, although local variations in conditions, volume and character of output, are always to be anticipated, even in plants located within the same neighborhood. It is easy to draw the conclusion that the installation of steam turbine equipment in times of station expansion tends to produce lower labor costs as well as fuel economies. Other things being equal, a substantial percentage of output in the form of a long-hour motor service, day or night, brings its own reward. It is

realized that the minor details which enter into the cost of production are not indicated in the range of figures which central stations are required to report to the state, and hence the above comparisons should not be taken as indices of administrative efficiency, save as they all fall within the limits of reasonably good practice. Causes beyond the control of a station may in any given year run its unit cost above the record of a previous twelve-month.

Wiring and Illumination

ILLUMINATING ENGINEERING IN SMALL CITIES.

An informal meeting of the Chicago Section of the Illuminating Engineering Society was held March 15 for lunch at the Great Northern Hotel. Members of the Illinois Gas Association attending the convention of that body on that date were invited to this meeting, which was partially held in their honor.

The topic for discussion was the necessity for illuminating engineering in small cities. Mr. J. R. Cravath, called upon to lead the discussion, said that small towns frequently represented extremes and that some of the best as well as the poorest examples of illuminating engineering could be found among them. In the early days of the tungsten lamp it was not uncommon to find some of the best-planned installations and the most generally intelligent application of proper reflectors and proper placing of lamps among the smaller towns where a progressive electric light company was in control.

An inspection of the store-lighting installations in any small town shows plainly the policy of the electric lighting or gas company. The common arrangements for electric lighting in stores previous to the advent of the tungsten lamp were either those of bare incandescent lamps hung from drop cords about on a level with the eye, or one or two arc lamps.

The general tendency in country towns is to use lamps hung low and devoid of all shading or reflecting glassware, be they electric light, gas or gasoline. On the other hand, some small towns now present as fine an array of well-planned store-lighting installations as can be found anywhere. Tungsten lamps, with proper reflectors hung high out of the range of vision, are the rule in such towns. It is not, however, an easy matter to get country merchants to see that a few dollars spent for proper reflectors are soon brought back in the shape of increased results for the money expended for electricity.

In residence lighting in country towns he said that contractors and dealers still find a market for the old-fashioned types of chandeliers with several arms having lamps placed at an angle. He could not help thinking that the continued market for this antiquated style was due to the fact that the dealers made no effort to educate customers to something better. Residences such as are common in country towns now have no real use for chandeliers with lamps hung low or numerous arms. One tungsten lamp with a proper reflector at the ceiling in the center of the room will be sufficient if direct lighting is used; or if the lighting is to be indirect one tungsten lamp with proper fixture hung the proper distance from the ceiling will be sufficient.

Mr. Fitzgerald, of Gary, Ind., said that he came from a new town where they are not troubled with old installations. Nevertheless, there is still some market for the old type of fixtures mentioned by the previous speaker. He told of the case of the new city hall in his town where the lighting was planned after the example set by the Studebaker offices in South Bend nearby. The lighting of these offices was the result of considerable illuminating engineering effort. Accordingly, the Gary city hall was equipped with reflectors for 100-watt tungsten lamps placed at the ceiling. However, the city appropriation gave out before the tungsten lamps were purchased and 40-watt tantalum lamps were installed instead. The result was, of course, insufficient light, so that the workers in the various rooms had to resort to drop cords. All of which, he said, illustrated the difficulty of getting well-made plans carried out.

It was announced that Albert Jackson Marshall, New York, would be in Chicago some time the latter part of March and that a meeting of the section probably would be held then to hear an address by Mr. Marshall.

It was voted to have at the April meeting of the section a presentation and discussion of various plans for lighting a certain room, plans for which room were to be sent out to various members some time in advance of the meeting, with invitations to contribute ideas as to just how such a room should be lighted.

ARCHITECT'S SPECIFICATIONS FOR ELECTRICAL WORK.

BY WILLIAM SHERIFF JONES.

Some years ago, when the installation of wires for conveying electrical energy for lamps and motors was a rarity and at which time the practice was not specialized, the architect no doubt was comparatively capable of specifying the mode of installation. Since that time, however, enormous strides have taken place in the development and utilization of electrical apparatus and of the number of men who are specialists in this field alone. Notwithstanding this evolution and development, the architect, generally speaking, is still devising specifications for electrical work, and in the majority of cases these specifications show little if any advancement over, and in some cases probably being copied directly from, previous specifications.

The writer has read specifications for electrical work covering three or four printed pages, the instruction gained from which could be more explicitly expressed in a single paragraph of three sentences. Such specifications, as a rule, go into the detail on minor factors, leaving the most important considerations indefinite, so that a contractor, bidding on the work, uses his own judgment on such considerations and, by reason of competition, figures on performing the work in the cheapest manner possible.

Then, cases also have been known where the contractor, after looking over the specifications, has laid them aside and gone ahead figuring on putting in an installation in accordance with the local municipal or fire underwriters' rules, making an allowance for changes in the type and location of apparatus, which the architect may demand when the work is in progress. Some specifications are so worded as to give the architect the right to demand any change in the scheme of wiring or fittings he desires, while in others he can be made to accept the cheapest class of material and workmanship. In the former case, the contractor is going to use, whenever allowed, the grade of material which is cheapest for him to install simply because he does not know to what expense he may be put later in making changes that may be demanded.

The average architect is not competent to devise specifications for a modern electrical installation, to so devise such specifications that an estimator may approximately determine the cost of material and labor, and to so define each particular detail that there will be no question as to the intent, so that the contractor will know exactly what is required without any further questioning.

In the case of electrical apparatus where there is constant development to keep up with increasing requirements and improvements in design, it is not an easy matter to prepare ideal specifications. Specifications of this character should be made to order for the particular installation it represents, the particular make or makes of materials and fittings should be specified and the entire installation plainly described from the service connection to the consuming devices.

One may well ask why he should write such elaborate specifications if there is to be no one appointed to see that the requirements are enforced. Instances have been known where, although the general scheme of wiring had been carried out, certain makes of wire, types of fittings, percentage of drop in

voltage, etc., which were specified were entirely ignored, inferior grades of wire and fittings being installed, and yet this work was accepted without question. It would indeed be extremely unwise to have the electrical engineer devise an extensive and complete set of specifications covering the work and then not have him see that his specifics are properly applied to the work. The specifications would in that case be of practically no value, as the contractor may or may not comply with them. The writer has found in his experience that the contractor studies the specifications when he is estimating on the work, not when he is installing it, and for this reason is liable to stray from its requirements.

It would be much more satisfactory, if the specifications are not to be rigidly enforced, to eliminate them entirely and in their place substitute a general description of the proposed installation and then require the contractor to submit with his proposal a set of specifications and plans. The specifications would, of course, be useless in either case, unless the work is to be inspected.

Specifications which are not detailed and complete and which leave authority with the architect or engineer to make any changes or alterations they may deem advisable, cause the work to cost approximately 10 per cent more, simply because the contractor does not know definitely what he is to do and knows that he may be made to change the apparatus after it has once been installed, and for this reason he adds a certain percentage to his estimate in order to protect himself against such emergency.

It is not the writer's intention to criticise the architect as an architect, but there are men in the electrical wiring field who are specializing in this particular branch of the electrical industry, who devote their entire time to the development and advancement of the work and it therefore appears that it is now time for the architect to turn this part of the designing work over to those who are more properly equipped for it.

The term "architect" used here defines the average architect as known through his specifications, and there are, of course, some exceptions. It is unreasonable to expect a man who divides his time between several vocations to be as well advised on any one of the several as the man who makes that one vocation a life study. The transference of this task would result in a much better class of construction and a lowering of the cost.

Below are cited a few of the requirements found in specifications drawn up by architects who are thoroughly competent otherwise:

"Asbestos-lined wood cut-out boxes specified in connection with a metal conduit system. Fixtures of this same system specified to be secured to wood blocks." "Wiring specified to be installed as concealed knob and tube work in a fireproof reinforced-concrete structure." "Weatherproof wire specified to be used in a steel conduit system outdoors, part of which was run underground across an areaway."

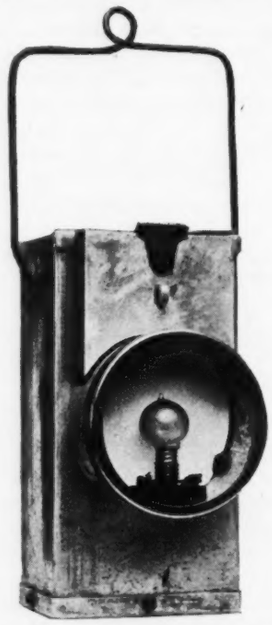
These instances are some of the extremes, and the majority are not so bad, but in the general run the architects' specifications of electrical work are not, by any means, satisfactory.

MINE LAMPS.

By Warren H. Miller.

The industrial engineer is called on for a strikingly varied range of activities in the doing of his daily work. Particularly in electricity is his attention shifted from the sublime to the infinitesimal, from minute to minute, as when he turns from paralleling large gas-driven alternators to locating telephone troubles, or from repairing a 1000-kw engine-generator to taking apart some such device as a mine lamp. To the general manager these things have all equal importance—he wants the 1000 kw to run some department or other, and he must have the mine lamps for the night watchmen. To him the cross-talking telephone is quite as important in dollars and cents as the gas engine, for some important departmental message may be held up by it, thus causing much damage and loss in the handling of manufactured products.

Really the little things in electricity require just about as much worry and care, and are almost as important cogs in the industrial gears, as are the big ones. One of these little things is the mine lamp, absolutely essential where explosive chemicals, gases, oils, varnishes and such inflammable materials exist in the air about the works. The night force, and the night watchmen in particular, simply must have them, or everything will come to a standstill with the going down of the sun. The writer has known of a single blown fuse, which cut the current off an oil-receiving house just at dusk, causing more damage in an hour than the entire electric equipment was worth. Here were thousands of gallons of gasolines, kerosenes, lubricating oils, and paraffines, just approaching the turn of the process, when someone shut off a motor that was temporarily connected to the same three-phase circuit as the bank of lighting transformers feeding energy to that section of the works. The kick of the motor reacted on the transformers, and blew out a



Tungsten Mine Lamp with Storage Cell.

dozen fuses in the lighting circuit, one of which controlled the line going to the receiving house which also had a fuse of its own. Before this particular fuse could be located and replaced the receiving house was in total darkness for over half an hour, and many tons of oil, of unknown quality, poured in without control. If ever electric light was wanted, even for a brief second, it was then! It was a great relief when the light was finally restored to find that the "cut" was only just beginning to change.

The mine lamps are quite as important as the foregoing in the actual economy of the works in dollars and cents—and it is fatal to have any but the best. Even the feeble spark that the 2-volt battery gives is quite enough to ignite the gas in a whole mine shaft, or a 100,000-barrel tank of gasoline. It must also be superfoolproof, because the average watchman or tankman knows a good deal more about nightsticks and measuring rods than he does about storage batteries. It must be capable of operating lying down on its side, or upside down; withstanding overloads and short-circuits, without getting buckled or sulphated; must have all working parts fully protected by a locked cover; must have no wires or switches in any way exposed to the air; and must run at least 18 hours on a single charge.

The writer has used several styles, of about a dozen lamps each, and tested numerous others. Only two makes were adopted, one with two lamps and a screw switch and liquid electrolyte, and the other with one tungsten lamp, screw switch and gelatine electrolyte. This latter seemed to be able to meet any and all requirements of its arduous existence. The writer regards the gelatine electrolyte feature as one essentially de-

s'rable. Gelatinous silica will absorb 60 times its volume of water, and nearly the same bulk of water and sulphuric acid. When a bottle full of it is struck it rings like steel and quivers like a three-dimension spring, but it works quite as well as liquid electrolyte, and is better than all of the various rubber valves and checks devised to keep the electrolyte in place in all positions of the battery. There is nothing new or patentable about it. It will do its work, no matter if the mine lamp has tumbled to the floor of the shanty, is handled upside down or right side up, or is used as the principal in a game of ball.

The second desirable feature is that all working parts must be under lock and key, or else so concealed that neither wires nor terminals can possibly be reached without taking the battery apart. This feature is beneficial in preventing the mine lamp being experimented with to run a 110-volt desk fan, for instance, or being hitched up to the induction coil of a medical battery—in fact, any one of a thousand ingenious experiments that may occur to the embryo Edison during the silent watches of the night. The battery must be capable of withstanding any amount of overload. If the grids are of plain lead they will buckle, and if the lead oxides are not chemically pure the battery will sulphate under continued short-circuit. This condition is quite possible, even with the working parts locked, for there is one outlet which cannot be locked and that is the lamp socket. The front glass must be capable of being unscrewed to replace burn-out lamps, and, sooner or later, some person will work at an old lamp base with solder and pliers until he has a pair of leads attached, and then he will discover the fatal tendency of the storage battery to yield up enormous currents on short-circuit; and, from that time on, iron wires will be burned up for the amusement of the public, small motors will be used to run fans, and practical jokes will be devised without end.

The battery used with a mine lamp should give at least 18 hours' service without any appreciable falling off in the brilliancy of the lamp. As to the switch, it should be mounted deep in a block of hard rubber, and opened and closed by a thumbscrew, screwing into the block, thus cutting out any possibility of the air penetrating into the switch. After 18 hours' service the battery should be recharged at the rate of 3 amp for eight consecutive hours. About 3 volts is the proper charging e.m.f. to give this amperage. Only distilled water should be used in making up evaporation, about a teaspoonful being inserted every week. As actually constructed, the battery itself is a three-plate paste lead cell, whith antimony grids, surrounded with the gelatine electrolyte, encased in a hard-rubber box which is protected by an aluminum case.

One of the mine lamps has withstood the following abuse tests: It was put on short-circuit after 22 hours' run, and the e.m.f. brought down to 0.2 volt. It then stood idle for 30 days, by which time it had not yet shown any signs of sulphating. It was then discharged at 5 amp, about four times normal current, for two hours, when it showed signs of exhaustion and it then lighted a lamp for six hours, instantly recovering its normal e.m.f. of 2 volts. The battery was subjected to other abuses, for it was recharged and then discharged at loads of from 2 amp to 10 amp for 50 minutes. When the e.m.f. had decreased to 1 volt, the cell was taken apart and the plates were still in good shape, not being buckled, and none of the active material had fallen out.

NEW TELEPHONE PATENTS.

IMPROVED APPARATUS.

Mr. F. Gottschalk, of New York City, has invented a transmitter with a closed mouthpiece. A large aperture is left in the transmitter front, and the face of the front is turned flat about this aperture. A small sheet-metal disk is then fastened to the front electrode, its rim lying in front of the plane of the transmitter front. Its walls clear the transmitter front, and its flare gives a rather wide mouth. Its bottom is closed. A felt packing of proper shape is secured to the rim and bears on the flat part of the transmitter front to seal the transmitter. The sound waves impinging upon the walls of the disk are transmitted to the electrode. It is claimed that this is an efficient and sanitary device.

A rather novel self-restoring drop has been patented by Mr. C. D. Enochs, of La Crosse. Wis. The drop is of the tubular type and is carried above the jack on the same mounting plate. The armature of the drop is readily removable, as its hinge piece slips under clips upon the drop shell. The terminals of the drop coil are flat and form three blades of a knife switch, the clips of which are hinged to the proper jack springs below. Thus, to remove a coil it is necessary merely to swing these clips down and pull off the armature, whereupon the coil becomes exposed for removal.

The restoration of the shutter depends upon spring-actuated sliding plates which nearly close the sleeve opening of the jack. These plates receive the plug tip and slide to right and left, respectively, as the plug enters the bore. In thus receding they move the spring and restore the shutter.

Another invention of Mr. Enochs is a double-wound receiver. The two windings are in series and differentially connected. The auxiliary winding is upon a copper spool and lies between the U magnet and the operating magnets. For the direct currents of a common battery system, the magnetomotive forces of the two windings neutralize, and therefore the receiver may be put directly in the circuit without affecting its efficacy or adjustment. For talking currents the front magnet alone is effective, the copper shell preventing any action of the auxiliary windings.

The receiver support has received the attention of Mr. R. Zinsmayer, of Sandusky, Ohio, and he has been granted a patent for his invention. An upright is attached to the stem of a desk stand set. Near its top is secured an arm which carries the receiver supporting arm proper. This latter may be raised to the proper height by swinging it upon a pin in the horizontal arm. When adjusted, the receiver arm is held in position, because its projecting rear end is arranged to engage teeth in the opposing edge of the upright. When no longer needed, a pull on the receiver disengages the arm from the teeth, a flexible arrangement being used at the hinge pin. The receiver is then dropped to a rest lever, which in turn depresses the hook lever of the desk stand.

A step-by-step selective device for selecting special stations on railway block lines has been patented by Mr. A. A. Monson, of North St. Paul. This apparatus enables a station to select and signal any other desired station on the line without the assistance of any central operator.

LETTER TO THE EDITOR.

Property in Patent Grants.

To the Editor of Electrical World:

SIR: The editorial comment to the writer's communication on "Patent Reform" in the issue of March 10, quoting from a recent writer touching the status of invention as property and its rights as such, raises several points of importance to the subject. Both academically and legally considered, invention is conceded to be property naturally existing and having the same relative rights that maintain respecting all classes of ownable things. But in recent years much is heard about "abstract invention" and "artificial rights" in invention, presumably in justification of the confiscatory character of the Constitution pertaining to the restricted period inventions may by law be exclusively owned.

Because invention is not physical does not provide reason for its not being natural property. It is as natural for the mind to think as it is for the soil to form and produce. The product of the one is as intrinsically natural as the product of the other, although differing in character according to the variance in their sources. There can be no abstract creation, therefore there can not be abstract invention. The concrete must be the original from which the abstract derives existence, and as invention is necessarily original discovery, it is by reason of its

very nature positively concrete and impossibly abstract, because abstraction must be duplication of the thing abstracted.

While abstract invention cannot be, *abstracts of invention* do exist in the material embodiments of the concrete invention, which are its tangible products. Invention is the soil from which improved shoes, hats and all new devices grow, each invention producing innumerable specimens of its kind. These are not the invention, but are multiple abstracts from it; and however many they may be, they cannot in the least subtract from the entity of the invention because, not being substance, it remains the same for all time, one solitary original existence. Its period of origin gives it oneness, and two persons cannot own its entirety at the same time. By virtue of its origin it becomes possessable but by one person, and the logical, natural right to possess it is inherent in its originator by right of creative possession.

Knowledge of this possession and of the exact thing possessed being attained by others subsequent to the period of origin of the invention, effects no change in the absolute natural right of the inventor, because concrete invention assumes its inexorable place in the world as surely as does a square foot of ground. And a million persons having full knowledge of its location, dimensions and productions gain thereby no right of possession. The divulging of an invention by voice, letter or material embodiment in no way abrogates the right of its inventor to its exclusive possession as the sole and only producer of its abstracts which may be possessed by whomsoever according to law. No civilized law can compel an inventor to divulge his invention against his will, and if he has the inherent and legal right to hold it in secrecy, in this enlightened age he certainly has the same rights to its exclusive possession openly. And if he has either natural or ethical right to exclusively possess it for a limited period openly, he and his heirs surely have the same right to hold it forever. And the law, while bargaining to induce inventors to openly divulge their inventions upon promise to them of a very limited monopoly, or sure protection for a time against commercial avarice, to-day completely fails to perform its part of the agreement, and becomes confiscatory by reason of its ignoble inefficiency relative to patents.

It is said in case 154 Fed, 358, that "Under its constitutional right to legislate for the promotion of the useful arts, Congress passed the patent statutes. The public policy thereby declared is this: Inventive minds may fail to produce many useful things that they would produce if stimulated by the promise of a substantial reward: *what is produced is the property of the inventor;* he and his heirs and assigns may hold it in secret until the end of time." And further along in the same decision the court says: "The monopoly is of the invention, the mental concept as distinguished from the materials that are brought together to give it body." So it is the concrete invention, and not the abstracts from it, which constitutes the natural property and the rights to possess it.

Newark, N. J. Chas. M. Haynes.

[The question of property right in inventions is one of public policy and subject to statute law and judicial precedent; its practical relations are beyond the scope of metaphysical argument.—Eds.]

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ATRICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Standardization of Electrical Machinery.—R. Orsettich.—A paper read before the Birmingham Section of the (Brit.) Inst. Elec. Eng. The author discusses the arrangements generally adopted in the manufacture of dynamo-electric machinery. He shows how electrical considerations have to be accommodated to suit commercial and mechanical considerations, and refers in detail to the various parts of electrical machines, describing the standardization advisable to facilitate quick and cheap production. Thus, the adoption of two lengths of core for each diameter is no doubt a disadvantage from a purely electrical point of view, because for each output, strictly speaking, there is only one diameter and one length which will give the best proportions. When using a long core as required for laminated poles it will be found again that this is not quite as satisfactory as a round core, but if in order to obtain a suitable ratio to give the room required for round poles, one had to go to the expense of adopting a much larger diameter, there is no doubt that the little sacrifice in the electrical design will be fully repaid in the cheapening of the production of the machine and in increasing its field of application, apart from the fact of a better efficiency obtained with the machine of smaller dimensions.—Lond. *Electrician,* March 11.

Armature Reaction and Compounding of Alternators.—J. E. Dalèmont and L. A. Herdt.—The authors first discuss the causes of the voltage drop in alternators and conclude that compounding of alternators can be very simply obtained by placing on the field poles of the alternator additional ampere-turns the magnetomotive force of which is made proportional to sin θ, where θ is the angle of phase lag between the no-load e.m.f. and the armature current. They describe two methods based on this principle. In one of these they consider a system of two coils, Fig. 1, at 90 deg., in which two currents out of phase with respect to one another by an angle θ will be set up. Inside these coils will be placed a rotor, and the torque set up by the induced currents in the same from the resultant field of the two coils will be proportional to I sin θ, if in one of the coils there flows a current proportional to, and in phase with, the load current of the alternator and in the other coil there flows a current proportional to, and in phase with, the no-load induced e.m.f. of the alternator. This last current can be obtained from a small auxiliary alternator giving an e.m.f. exactly in phase and proportional to the e.m.f. of the alternator to be compounded. This system of coils, which is simply a phasemeter (Dobrowolsky system), will work on a lever in which, by taking a defined position for each value of the torque set in it, proportional to I sin θ, will cause a direct current in

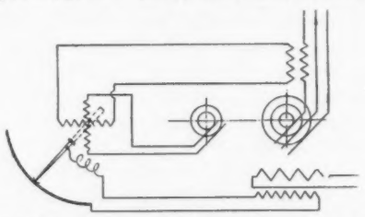


Fig. 1—Armature Reaction and Compounding of Alternators.

the additional coils placed on the field pole to vary as I sin θ. This system assumes that the alternator is a single-phase one, or a three-phase with equal loads on the phases and at equal power-factors.—Lond. *Electrician,* March 11.

Induction Machines.—G. Benischke.—The non-synchronous three-phase machine when operating below synchronism acts as motor, while when operating above synchronism it acts as generator. When passing through synchronism a wattmeter connected to the machine shows a sudden decrease of power. The author has investigated this phenomenon. To pass the induction machine through synchronism, it is, of course, necessary to drive it by means of some outside source. For this purpose he used a direct-current shunt motor, and he shows that the sudden change of power is due to the fact that at the moment of synchronism the total iron losses are transferred from the induction machine to the driving motor.—*Elek. Zeit.,* March 10.

Short-Circuiting of Large Electric Generators.—M. WALKER.—A paper read before the (Brit.) Inst. Elec. Eng. on the short-circuiting of large electric generators and the resulting force on armature windings. Oscillograph records are given, showing the current which flows when a 5500-kw generator is short-circuited at its terminals. The forces operating on the armature windings are approximately calculated, and the methods adopted by various designers to support armature windings are illustrated. The phenomena accompanying the short-circuiting of direct-current generators and rotary converters are also considered, and oscillograms are given showing the current on short-circuit and the voltage rise across the circuit breaker.—Lond. *Electrician,* March 11.

Lamps and Lighting.

Price of Metallic-Filament Lamps.—VON GAISBERG.—The author discusses the reduction of the price of metallic-filament lamps from the standpoint of the consumer. With normal energy prices, the replacement of carbon lamps by metallic-filament lamps of the same candle-power means a great saving in the cost, and besides better illumination, because the metallic-filament lamps maintain their original candle-power much better than the carbon lamps. It is probable, however that the 25-cp metallic-filament lamp will be used more often instead of the 16-cp lamp. Some people are complaining that the low-candle-power metallic-filament lamps (16-cp, 110-volt) and 25-cp, 220-volt lamps, have been reduced very little in price, so that they are now only a little cheaper than lamps of higher candle-power. It is important that the quality and strength of the lamps should remain the same as heretofore. At present lamps are sold and advertised which consume less than ordinary metallic-filament lamps (1.1 watts per hefner candle-power), but are not strong, and, therefore, have a short life. Ordinary metallic-filament lamps can be made strong enough even for rough usage. Thus the 16-cp, 105-volt lamps used on the docks in Hamburg, where they are subjected to considerable vibration by the landing steamers, have an average life of more than 1200 hours.—*Elek. Zeit.,* March 10.

Metallic-Filament Lamps for Street Lighting.—An editorial stating that while the 50-cp metallic-filament lamp has been employed for some time past in the illumination of shop windows, it is only recently that these lamps have been widely adopted in England, both singly and in groups for street lighting. At the present time, in fact, these lamps are proving serious competitors of the small enclosed-arc lamp for all purposes; while in most of those towns where carbon-filament lamps were once used for side-street lighting the metallic-filament lamp now holds undisputed sway. Moreover, the same lamps are now being used in streets where gas was once the one and only illuminant. The osram lamp is now also being used in Victoria Street, in London. The Westminster City Council is carrying out a series of experiments in that neighborhood to determine the relative merits of flame-arc, metallic-filament and high-pressure gas lighting. Jandus flame lamps are being used at the Abbey end of the street, and osram lamps, placed in lanterns containing either one 300-cp or three 100-cp units, in the neighborhood of the Army and Navy Stores.—Lond. *Electrician,* March 11.

Tungsten Lamp.—A note on a recent British patent (6936, 1909; March 3, 1910) of the Westinghouse Metal Filament Lamp Company (A. Lederer, of Vienna). Raw tungsten filaments containing 2.5 per cent of carbon are decarbonized by raising them to a temperature of from 1200 deg. C. to 1300 deg. C. in the presence of dry hydrogen, when the amount of carbon is reduced to about 0.04 per cent. The hydrogen combines with the carbon forming methane. The absence of oxygen prevents oxidation of the tungsten with the resultant bright places in the filament.—Lond. *Elec. Eng'ing,* March 10.

Metallic-Filament Lamps.—Continuations of the long serial summing up recent progress in the manufacture of metallic-filament lamps on the basis of patent specifications. The methods of removing the carbon from the filament are discussed in *Zeit. f. Beleucht.,* Feb. 20, the method of connecting the filament with the leading-in wires in *Zeit. f. Beleucht.,* Feb. 28, and the methods of mounting the metallic-filament loops in the form of a rigid frame in *Zeit. f. Beleucht.,* March 10.

Manufacture of Incandescent Lamps.—A note on a recent British patent (8351, 1909; March 3, 1910) of the British Thomson-Houston Company (General Electric Company of this country) for an automatic machine, in which the various steps of blowing off the neck of a bulb to the proper length, placing the bulb in proper relation to the stem and filament-carrier, and sealing the stem into the bulb are all carried out automatically.—Lond. *Elec. Eng'ing,* March 10.

Arc Lamp.—An illustrated description of the "Multax" arc lamp made by a British company. This has been designed to give long burning hours with a short over-all length and without resorting to the magazine principle. A special form of multiple electrode is used consisting of two impregnated cores surrounded by a hard carbon shell of oval section, and joined by a narrow bridge of soft impregnated material. The arc burns at one core until a certain limiting length is reached, and then travels along the bridge to the other core. The bridge not only ensures that the arc will travel from core to core without flickering, but also prevents any change of color due to the arc burning from the hard carbon and not being fed with salts. The cross-section of the double-cored electrode for direct-current circuits is shown in Fig. 2. The lamp is made in two sizes: The small size has an over-all length of 2 ft. 9 in., takes 16-in. electrodes and gives from 18 to 20 burning hours, while the large size, with an over-all length of 3 ft. 3 in., takes 24-in. electrodes and gives from 34 to 36 burning hours. It is also intended to make an exactly similar lamp with a triple-core 24-in. electrode, giving 54 burning hours.—Lond. *Elec. Eng'ing,* March 10.

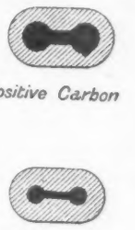


Fig. 2—Sections of Electrodes.

Protective Nets for Arc Lamps.—S. LEES,—An illustrated article giving details of protective nets for arc-lamp globes.—Lond. *Elec. Review,* March 11.

Illumination.—S. P. THOMPSON.—His concluding lecture before the Royal Institute on the subject of illumination. The speaker showed a number of curves of comparative costs of lighting with various illuminants. Of the electrical sources, the quartz-tube mercury-vapor lamp is the cheapest, the flame-arc lamp coming second with a figure of from 1 cent to 3 cents per 1000 candle-hours for running costs only. The carbon-filament lamp was the most expensive illuminant of all. After comparing the distribution curves of a number of different light sources, Thompson passed on to consider illumination of a surface. For reading or writing the illumination should never be less than 1.5 ft.-candles. In factories in Holland the legal minimum is 0.9 ft.-candles. The illumination from a bright sky is from 3 ft.-candles to 6 ft.-candles. The lecturer emphasized the importance of adequate lighting in schools. In Breslau (Germany) the percentage of myopia cases (short-sightedness) increases from 6 per cent in the lower standards to 26 per cent in the upper standards, and to 59 per cent in the universities. This was attributed by the lecturer chiefly to bad illumination. In Birmingham the percentage has been found to increase from 5 per cent in the lower schools to 20 per cent in the training colleges. The subject is not a new one, as a photometer was in use in schools in Russia over 20 years ago. Another important, but different, matter is the prevention of glare, or the direct exposure of the eyes to sources of high intrinsic brilliancy. The eye cannot look with comfort at a surface having a brilliancy of more than 1 cp per square inch. By frosting a lamp globe the light can be scattered, so that whereas a tungsten filament has an intrinsic brilliancy of 1000 cp per square inch a frosted lamp has only about 5, and does not offend the eye so much. An even better way is to use only the light reflected from a rough white surface, as in indirect lighting by hidden lamps throwing light onto a white ceiling. However, these are inefficient methods of scattering the light.

Recently much headway has been made with prismatic globes and shades.—Lond. *Elec. Eng'ing*, March 10.

Fittings.—An illustrated description of various fittings and accessories for lamps recently placed on the market in England.—Lond. *Elec. Eng'ing*, March 10.

Horizontal Illumination.—P. Hoegner.—The first part of an article illustrated by diagrams on a method for calculating the horizontal illumination of streets and squares. In the present installment the author discusses the mean horizontal illumination. The article is to be concluded.—*Elek. Zeit.*, March 10.

Generation, Transmission and Distribution.

Electricity in Mines.—Electric power is now being used to a very large extent in mines in Germany. Installations are being standardized and the German Association of Electrical Engineers has issued a set of rules for electric underground installations in mines. Electric motors are used for pumping, ventilating, winding, etc. Since electric energy becomes cheaper from year to year, electric driving becomes more economical. In the small Upper Silesia mining district, there were used in 1909 generators having an aggregate rating of 92,000 kw, some plants having ratings of about 6000 kw. To this is to be added the power station of the Upper Silesia Electricity Works with a rating of 34,000 kw, which distributes its energy chiefly to mines. For transmission e.m.fs. of 10,000 volts, 20,000 volts and 50,000 volts are in use. With a rating of 3000 kw some power stations furnish to their own mines alone more than 8,000,000 kw-hours per year, while the Upper Silesia Electricity Works, with a rating of 34,000 kw, generated 85,000,000 kw-hours. The cost of the kw-hour in the Upper Silesia stations is given as 0.75 cent, including interest and amortization. The Upper Silesia Electricity Works sell energy at this price except in peak-load hours, while for such consumers who want continuous supply of energy, including the peak-load hours, the price is from 1 cent to 1.25 cents. In the Westphalian mining district there are generators with an aggregate rating of 170,000 kw and more than 3000 motors, with a rating of more than 170,000 hp. The cost of the kw-hour is given as from 0.75 cent to 0.625 cent or less, including interest and amortization. The rating of the Rhenish-Westphalia Electricity Works is 55,000 kw; the power house in Essen generates 90,000,000 kw-hours per year, and the total of the kw-hours generated in the different power houses of this company is 140,000,000. The selling price of the kw-hour is the same as that of the Upper Silesia Electricity Works. There are some other districts in Germany where electricity is used on a large scale for mines.—*Elek. Zeit.*, March 10.

Electricity in South African Mines.—A review of the use of electric motors in the gold mines on the Witwatersrand, in South Africa. Only in the last two years has electricity been introduced there. The cause of the slow development has been more of a financial than a technical nature. The central station built by Siemens & Halske in 1895 for 7000 hp did not develop as satisfactorily as expected, on account of the Boer War. The transmission of energy from the Victoria Falls to Johannesburg has been abandoned for the present. However, the Siemens & Halske plant has been enlarged by about 6000 kw and a new plant near Simmerpan, with a rating of 12,000 kw, has been erected. Some details are given of the same, steam turbines being used. Since one of the largest mining companies has recently decided to introduce electric motors, a new central station of 9000 kw is to be erected.—*Elek. Zeit.*, March 10.

Oil Engines.—Engelmann.—An abstract of a paper read before the Association of Austrian and Hungarian Electricity Works. The author gave an account of his experience with Diesel engines. Machines up to about 300 hp are perfectly satisfactory and reliable. The economy of operation compared with the steam engine, due to less consumption of fuel, is considerable even with the price of raw oil of $1.80 per 100 kg; the saving means from 30 per cent to 55 per cent. The attendance of the Diesel engines, however, must be very careful and special attention must be paid to the lubrication and cooling of the cylinders and the high-pressure valves. Concerning Diesel engines rated at from 500 hp to 800 hp, no conclusive experience is yet available as to the reliability of operation, but the consumption of oil and the quickness of starting and the connection in parallel are satisfactory. The consumption of raw oil by two 300-hp Diesel engines in the electricity plant of Pressburg was found to be 266.4 grams per kw-hour at full load, 275.2 grams at three-quarter load, and

Load		Gram per kw-hour.	Gram per hp-hour.
Kw.	Hp.		
100	149	0.5	0.417
200	296	0.328	0.266
350	517	0.29	0.196

312.8 grams at half load. For two four-cylinder Diesel engines, each of 800 hp and 167 r.p.m., in the station of St. Poelten, the above figures of consumption of raw oil are given. —*Elek. Zeit.*, March 10.

Water Turbines.—H. B. Taylor.—An illustrated review of the development of the hydraulic reaction turbine in America with special reference to progress in design and in avoiding erosion.—*Eng. Mag.*, March.

Pumps.—F. zur Needon.—The third article on the design, construction and operation of high-lift centrifugal pumps. In this installment the author deals with structural features and manufacturing considerations.—*Eng. Mag.*, March.

Traction.

Interurban Line.—An illustrated description of the construction features of the new interurban line from Warsaw to Peru, Ind. Three-phase energy is transmitted at 33,000 volts from the station over aluminum conductors to five rotary-converter substations. Energy is distributed to the cars by a bracket-supported No. 3-0 grooved-trolley wire and an aluminum supplementary feeder with a cross-section equivalent to 450,000 circ. mils of copper.—*Elec. R'y Jour.*, March 19.

Installations, Systems and Appliances.

Electric Bells Connected to Supply Circuits.—An illustrated description of an electric bell of English make which is worked directly off a lighting circuit using either direct current or alternating current. The construction of the bell is shown in

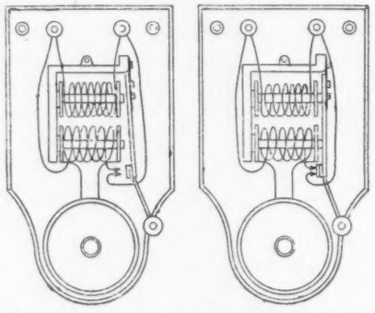


Fig. 3—Diagram of Magnet Windings.

Fig. 3, with two different positions of the armature. It is practically of the standard type, but the two coils are wound in opposite directions, and connected in parallel to the outer circuit. In the case of the lower coil this connection is made through a small switch which is closed only when the bell armature is attracted, as shown in the right hand of the diagram. Fig. 4 shows the method applied to an ordinary bell installation. The supply mains are connected to the bell through a lamp and push button. When the button is pressed the lamp

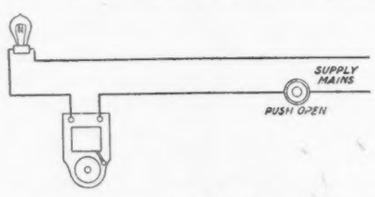


Fig. 4—Bell on Ordinary Supply Mains.

momentarily lights up, and the armature of the bell is attracted into the position shown on the right hand of the first diagram. This causes current to pass through the lower bell coil, and since the windings of the coils are differential, the attraction of the upper coil is neutralized and the armature flies back to the position shown on the left hand of the first diagram. This "making" and "breaking" is continued so long as the main circuit is closed. To allow the lamp to be used for lighting purposes at night, a modification of the above arrangement may be employed, as shown in Fig. 5. The push button

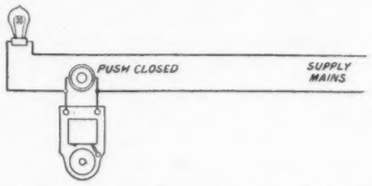


Fig. 5—Lamp on Bell Circuit for Lighting Purposes.

is connected in parallel with the bell, and is so arranged that it is ordinarily kept closed. Opening it causes the bell to ring, as explained above. In this way the lamp used for lighting a dark passage or other place where light is always wanted can be employed in a dual capacity. The application of this bell to tramcars is also noted.—Lond. *Electrician,* March 11.

Charging Small Lighting Consumers.—The recent paper by H. W. Handcock and A. H. Dykes, in which the authors suggested a fixed price per lamp per year for small consumers, and a dusk-to-dawn supply in scattered districts, was again read and discussed in Manchester. Several speakers referred to the growing importance of the motor load and the higher standard of lighting, both of which are acting to counterbalance the reduction in revenue due to the use of metallic-filament lamps. Speakers differed on the subject of free wiring, and several urged the necessity for a simple system of charging which all consumers could understand. Two speakers spoke highly of the ratable value basis.—Lond. *Elec. Eng'ing,* March 10.

Dangerous Rise of Voltage.—A. R. GARNIER.—The author discusses the phenomena which may take place when an inductance is in series with a capacity, and deals with the dangers of occurrence of high voltages when unsuitable transformer connections are employed. The different ways of transformer connections are systematically summed up in tables and the conditions are stated in which resonance is possible.—*L'Industrie Elec.*, March 10.

Electrophysics and Magnetism.

Ultraviolet Light.—R. A. MILLIKAN.—An abstract of a Physical Society paper on some new values of the positive potentials assumed by metals in a high vacuum under the influence of ultraviolet light. All previous observations upon the positive potentials assumed by metals under the influence of ultraviolet light have given values falling between 0 volt and 5 volts. The observations now reported were made upon five different metals, four of which had been kept for three years in the best possible vacuum obtainable with a mercury pump without the aid of a charcoal bulb and liquid air. The average pressure within the vacuum chamber was between 0.0001 mm and 0.000001 mm of mercury. Observations taken upon these same four metals three years ago, when they were first inserted in the vacuum chamber gave values of the positive potentials varying between 0 volt and 1.34 volts. The values now obtained with the same source as that originally used are from 10 to 30 times as large. Thus, the original value observed in the case of silver was 1.34 volts; the largest value in the case of zinc was 0.2 volt; a value 30 times as large, namely, 6.6 volts, has recently been obtained. The original value in the case of iron was 1.2 volts; it is now 15.4 volts. Copper showed at first a potential of 1.1 volts; it now shows a potential of more than 20 volts. These increases have been brought about in part, at least, if not wholly, by prolonged and powerful illumination of the surfaces of the metals with ultraviolet light. A test piece of aluminum when placed in the best vacuum obtainable by Dewar's method, and under powerful illumination intermittently for three weeks, had its positive potential gradually increased from 0.25 volt to 12.5 volts. The increase pertains not merely to the maximum value of the positive potential, but also to the rate at which the positive potential is gained at any potential between zero and the maximum. A plausible explanation of this change in the apparent velocity of projection of electrons from metals is found in the assumption that there exists at the surface of every metal, even in a good vacuum, a gaseous film which gives rise to an electrical double layer of negative sign on the outside, positive on the inside. Electrons liberated by the ultraviolet light are retarded in passing out through this film and escape with a very low velocity. Prolonged illumination with ultraviolet light drives out this gas and breaks up the double layer. The electrons then escape with their initial velocities of projection.—*Phys. Review,* February.

Units, Measurements and Instruments.

Cast-Iron Permanent Magnets.—A note on a new process for the manufacture of permanent magnets for magnetos, instruments, etc., used by a British company to the extent of manufacturing some 2000 magnets per week. The process consists in a certain heat and chemical treatment of the cast-iron magnets, details of which are, however, not given. The magnets thus made are about 20 per cent less powerful than a corresponding magnet of the best steel, or 10 per cent less than the average magnet, while they are claimed to be about equal as regards permanence. An advantage of this magnet is that the poles and fixing-down lugs can be cast all at once into the shape desired, whereas with a steel magnet separate poles have to be fitted, thus necessitating the magnet limbs being ground and drilled.—Lond. *Elec. Eng'ing,* March 10.

Telegraphy, Telephony and Signals.

Telephone Circuits.—J. PERRY.—An abstract of a (London) Physical Society paper on a new method for finding the distance between loading coils or in general of contrivances (any combination of resistances, inductances, capacities and leaks to earth), in order to make their effect the same as that of a uniform line. His method shows that in some cases the detached contrivances may produce much the same and in others very different effects from what might have been expected from a study of the cable with continuous properties. It was shown that a line may have contrivances somewhat far apart which will tune it to a musical note merely, so that it acts almost like an ohmic resistance, but which will not transmit well the currents of other frequencies, and that for the commercial transmission of speech there must be a compromise. The author impressed on the audience the fact that this method of calculation could be taught to quite non-mathematical people. There was a long discussion of the paper. B. S. Cohen emphasized that it was not only useless, but absolutely harmful for telephone transmission to tune a line to any particular frequency. O'Meara, A. W. Martin (see next abstract), A. Russell, J. A. Fleming and G. M. Shepherd also discussed the paper. Several of the speakers spoke with high praise of the papers of Dr. Kennelly on telephonic transmission.—Lond. *Electrician,* March 11.

Loaded Telephone Cables.—In the discussion of Perry's paper on telephone circuits (see above), Major O'Meara gave some information on tests made by the British Post Office on the loading of telephone cables. The question came up in connection with a new cable between England and France. It was established experimentally that the theoretical formulas for loaded cables do apply to the case of conductors covered with gutta percha. For the new submarine cable use was made of coils with a resistance of less than 6 ohms, and an inductance of 0.100 henry at 750 cycles per second. The new telephone cable consists of 160 lb. of copper wire and 300 lb. of gutta percha per mile. It has a conductor resistance per loop-mile of 12.5 ohms (excluding the coils) and a wire-to-wire capacity of

0.12 microfarad per mile. In an unloaded state, at attenuation constant of this cable is 0.045 per mile. He also emphasized that the question of leakage is of great importance. A. W. Martin gave further information on tests made by the Post Office Department in connection with the 18-ohm-per-mile-of-loop cable. The cable is 38.5 miles in length, contains 28 pairs of wires, and by joining pairs in series to and fro in the cable long lengths of circuit were made up. A switch was arranged so that a telephone circuit could be completed through the cable under test, or through an adjustable standard cable, the attenuation constant per mile of which was known to be 0.103. The amount of standard cable through which the same volume of speech was obtained as through the length of circuit under test, was called the standard cable equivalent of the latter. Knowing the attenuation constant of the standard cable it is, of course, easy to deduce that of the circuit under test. They experimented both with air-core coils and with iron-core coils, but since the latter introduce less resistance for a given inductance than do the air-core coils and are otherwise just as satisfactory, they are preferred. The constants of the circuits were 100 lb. per mile, the mean resistance 18 ohms per mile of loop, $R = 0.055$ microfarad per mile of loop, and $L = 0.001$ henry. The constants of the coil were inductance 133 millihenrys; effective resistance of the whole coil with direct current, 3.5 ohms; with a frequency of 750 cycles, 5.4 ohms, and with a frequency of 2000 periods, 15 ohms. The results

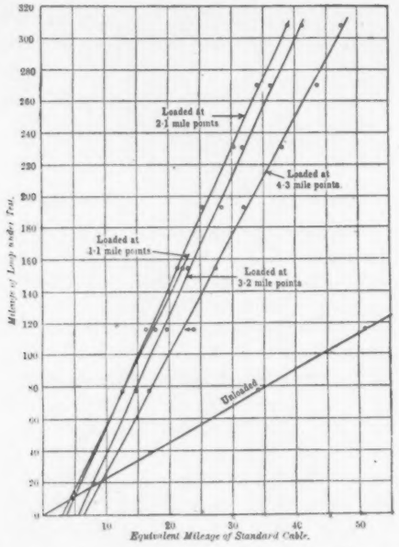

Loaded at 2·1 mile points
Loaded at 4·3 mile points
Loaded at 3·2 mile points
Loaded at 1·1 mile points
Unloaded
Equivalent Mileage of Standard Cable.

Fig. 6—Results of Tests of Loaded Telephone cables.

of the test are given in Fig. 6. The intercept between the origin and the point at which any curve cuts the abscissa is generally taken as representing the terminal loss due to the apparatus. The true equivalents of the loaded lines would, of course, be obtained by drawing curves through the origin parallel to those shown in the figure. If this be done, and the attenuation constants per mile be determined from the slopes of the curves, they will be found to be as shown in column 3 of the above table, the procedure being as follows: Take the 2.1-mile spacing. It will be found that, excluding terminal loss, 200 miles of loaded circuit is equivalent to 23 miles of standard cable. If the attenuation per mile for standard cable be 0.103 at 750 cycles, then that of the loaded loop will be $23 \times 0.103/200 = 0.012$ per mile.

Coils spaced apart, miles.	Attenuation constant at 750 cycles per mile. Calculated.	Observed.	Coils per wave at 2000 cycles.	Articulation.
1.1	0.011	0.013	5.6	Very good
2.1	0.012	0.012	4.0	Very good
3.2	0.013	0.012	3.3	Good
4.3	0.014	0.014	2.8	Bad
Unloaded	0.042	0.045	..	....

The calculated and observed results agree very closely. Where the number of coils per wave at the above-mentioned frequency exceeded three, the quality of speech was satisfactory, but where it was less than this number it became bad. The articulation was, indeed, so inferior that the circuits were unfit for public use. The coils have actually been left in the circuits at 3.2-mile intervals, since this is the most economical arrangement having regard to cost and the improvement obtained. With this spacing the treated circuits are about 3.7 times as good as the same loops unloaded. Experiments were also made to determine the effect of tapering the inductance toward the end of the loaded circuits. The general experience was that, although any of these devices was beneficial upon a short length of loaded line, inasmuch as it reduced the terminal loss, no good object would be served in providing them at the ends of lengthy loaded underground trunk lines, because these are normally subjected to extension by unloaded loops, such as junctions and subscribers' circuits, which themselves act as terminal tapers. If a length of loaded line be placed between two lengths of unloaded circuit, the standard cable equivalent of the three lengths in series is always found to be equal to the sum of the equivalents of the parts excluding the terminal loss which exists when the loaded circuit is separately measured. (A very long serial by the same author, A. W. Martin, on this subject is now appearing in Lond. *Elec. Review*, as has already been noticed in the Digest.)—Lond. *Electrician*, March 11.

Miscellaneous.

Lightning Conductors.—After consultation with Sir Oliver Lodge, K. Hedges and S. G. C. Russell, the Phœnix Assurance Company, in England, has issued a set of rules for the erection of lightning conductors. In an introduction to the rules the "ideal method of protection" is discussed; it is the "bird-cage" system of conductors. For an ordinary building a sufficient practical approach to ideal conditions is attained by taking advantage of metal work outside it, and adding a few other conductors, so as to surround it and imitate roughly a metallic enclosure. Under expert supervision this can generally be accomplished by utilizing the rain-water pipes and gutters as part of the system. Joints in the pipes and gutters act more securely when bonded together or made electrically continuous. The ordinary conductors must be fixed in addition, and the whole system of pipes, etc., together with the special conductors, may advantageously be interconnected by a horizontal conductor taken round the buildings, from 2 ft. to 3 ft. above the ground level or buried in the ground. The complete system should then be efficiently connected to earth at several places. A building with trees adjacent to it, or dominated by a steeple or other lofty building, must not be considered as immune. The set of rules proper, which are printed in full, refer to conductors, their material, method of running, and joints; elevation rods; holdfasts; number of conductors and area of protection; earth connections and number; test and examination of earth connections; special risks, churches, factory chimneys, flagstaffs on buildings, church spires and lofty towers.—Lond. *Electrician*, March 11.

Porcelain for Electric Purposes.—J. and M. Rousseau.—The conclusion of their article on the manufacture and testing of porcelain for electrical purposes. The authors emphasize the importance of the form of the insulator and finally sum up the following laws: For each insulator there exists a critical voltage below which the insulation resistance is constant, and this critical voltage varies with the dimensions, the form and the condition of the insulator. By experience it has been found that the critical tension is higher the larger the dimensions of the insulator and the greater the diameter of the upper petticoat and the dryer the insulator. If the voltage is increased above the critical value the insulation resistance decreases the more rapidly the smaller the diameter of the upper petticoat. Good porcelain for electrical purposes has considerable mechanical strength. It resists per square centimeter 3000 kg on compression and 1500 kw on tensile tests, when it is homo-

geneous and vitrified. With 1 mm thickness it is perforated only by an e.m.f. of 92,000 volts. Unfortunately, in baking the porcelain, invisible cracks often develop and it is necessary to test the porcelain most carefully—*L'Industrie Elec.*, March 10.

New Apparatus and Appliances

SWITCH FOR IMITATION CANDLE.

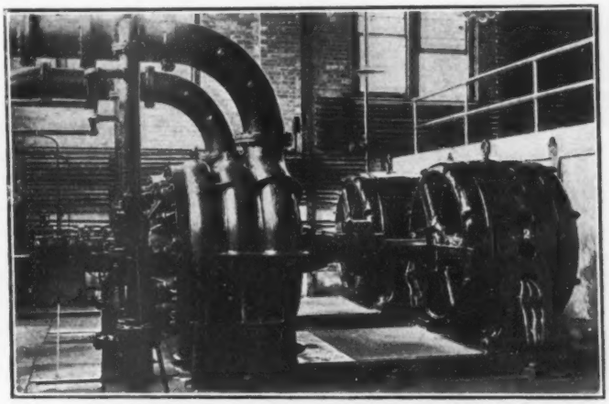
A compact adaptation to which the push-switch mechanism developed by the Cutler-Hammer Manufacturing Company readily lends itself is shown in the accompanying illustration of a candelabrum bracket with the switch contained in the "candle" socket. The miniature switch device is arranged to fit inside the socket, and carries a vertical standard which holds the lamp receptacle at the proper height to give the effect of a flame above the hollow porcelain dummy "candle." All wiring and connections in the fixture are readily accessible by removing this porcelain.

The switch is operated by the familiar double push-button arrangement, which extends out through the case of the art-metal socket, and is the only external evidence of the electrical nature of the device. The switch mechanism is adaptable for various styles of candelabra fixtures, and the vertical standard which holds the shaft can be supplied for any length of candle. This switch is made by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

Candelabra Switch.

MOTOR-DRIVEN PUMPS AT DEPEW, N. Y.

The city of Depew, N. Y., is furnished with water from Lake Erie by two 300-hp, electrically driven, centrifugal pumping sets. The electrical equipment of this water-works station comprises two 300-hp, 400-volt, three-phase, 25-cycle, Westinghouse-type induction motors, operating at 480 r.p.m. Each motor is connected directly, through flexible couplings, to a 12-inch, three-stage Worthington centrifugal pump. The motors are operated from panels which are not shown in the accompanying illustration and which carry the auto-starter switches, recording gages, voltmeters, wattmeters, etc. An average meter reading shows the duty of each motor, when fully loaded, to be 270 kw, or 320 hp. This electrical equipment in the Depew & Lake Erie pumping plant replaced expensive and bulky steam-pumping machinery, and the resulting improved economy has fully justified the claims for superior efficiency which induced the change in motive power and the scrapping of a lot of valuable machinery. The steam pumps may still be used to advantage, however, during the cold months of the year, when the exhaust steam can be disposed of profitably by use in steam-heating systems. Such use, in fact, has become almost the remaining utility of such steam-driven apparatus, where electric power is available.



Motor-Driven Pumps at Depew, N. Y.

COLLAPSIBLE STEEL HORSE.

The S. M. Hildreth Company, of 2 Rector Street, New York, has brought out a collapsible steel horse which is shown open and ready for use in Fig. 1 herewith and folded in Fig. 2. The device is made of angle iron and is rigid and strong. It is made in several heights and lengths and the collapsible feature is that the legs fold up when the trestle is not in use. A minimum storage space is thus required and the trestle can be easily handled and transported from place to place. Being light in weight and applicable to so many uses and for so many trades, the device will doubtless find a wide use. Electricians and electrical contractors and others engaged in erecting electrical apparatus, the wiring of buildings, etc., especially can employ it to advantage.

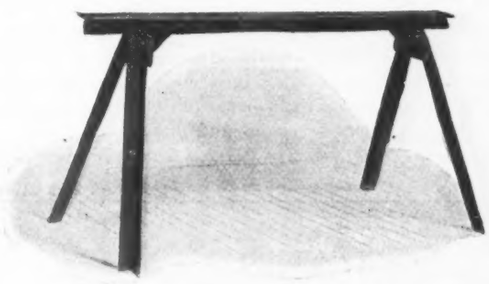


Fig. 1—Collapsible Steel Horse—Open.

Fig. 2—Collapsible Steel Horse—Folded.

ELECTRICAL SHOP TESTS OF GASOLINE AUTOMOBILES.

The accompanying cuts illustrate an interesting electrical method for making shop tests of automobile machinery, as employed in the factory of Thomas B. Jeffery & Company, Kenosha, Wis., where the well-known "Rambler" automobile is made.

Because it is more difficult to detect flaws in a completed engine and a completed chassis than to discover weaknesses in separate parts, one entire building—covering a floor space equivalent to one-half the floor area of the original Rambler factory—is devoted to motor and chassis testing alone. Seventeen

Fig. 1—Testing Automobile Engines Unmounted.

dynamos are here arranged on 17 concrete stands, each stand making a complete unit, with necessary cooling apparatus and means to carry off the exhaust gases.

When a machine is completed in the engine-assembly department it is picked up on a traveling crane, carried to the testing department, and located on one of these testing stands, where it is first limbered up and then tested to establish its horse-power rating, and to detect its most insignificant faults before it is placed in the car. First, the dynamo turns the engine while the new parts are being thoroughly limbered, preparatory to running the engine under its own power. Then the operation is reversed, the engine is started and drives the dynamo. This operation continues for many hours, until the engine is thor-

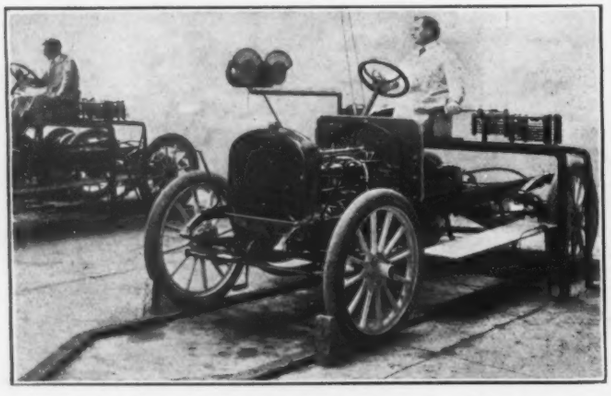


Fig. 2—Testing Automobile Engines when Mounted.

oughly worked in, and scientific tests show that it is delivering its rated horse-power.

Every engine is closely watched during this process, and if trouble of any kind, such as a knocking bearing, noisy gears or valves becomes apparent the difficulty is immediately remedied. Before it leaves this stand, the engine must run without vibration and without noise. These 17 stands are constantly busy, while in addition there is one reserve stand for experimental purposes.

After an engine is assembled in the chassis, it is returned to this department, and a rear wheel test is taken. The car is securely clamped on two immense rollers, from which a

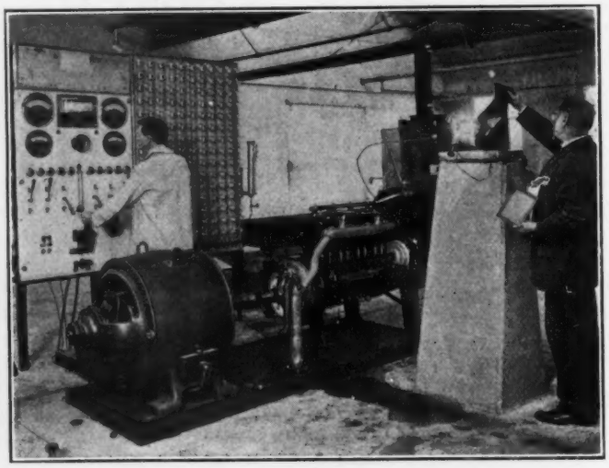
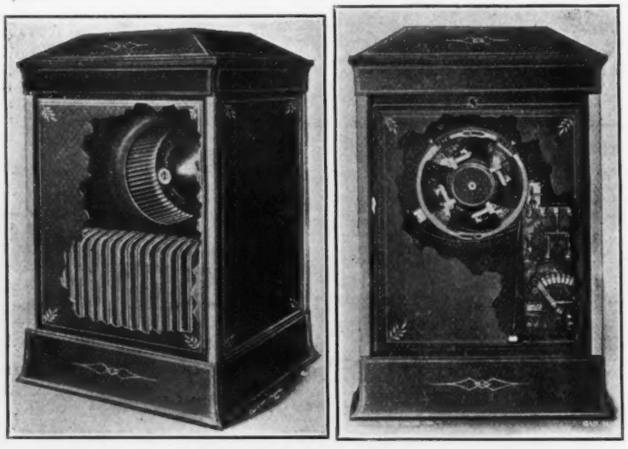


Fig. 3—Laboratory Tests of New Type of Automobile Engine.

dynamo is driven by means of a chain. The power delivered is determined from a wattmeter connected to the dynamo. This test detects any possible error in assembly, any difficulty in transmission or axle, and assures uniform results at the rear wheels.

ELECTRICAL VENTILATING MACHINES.

The Garner ventilating machines have been built to combine the principles of the built-in system, but instead of a central plant they are made up in comparatively small units to be installed directly within the area to be ventilated. The apparatus can thus be operated just as needed, and each machine is entirely independent of all the others. The machines can be easily installed after the building is erected and may be moved from one location to another, if necessary. Each machine is said to be able to deliver over 100,000 cu. ft. of air per hour directly into the room. The air is brought into the machine at the bottom or through an opening cut into the iron casting which forms the base. The air supply-duct is built from the machine



Figs. 1 and 2—Electrical Ventilating Machines.

to the best place to secure the outside fresh air. This may be through a panel at the top or bottom of a window or through an opening made in the wall, skylight or floor. The air on entering the machine passes over pressed steel heating coils connected with the steam-heating plant of the building. By this means air may be warmed in cold weather when it is impossible to ventilate properly with cold air. Just before leaving

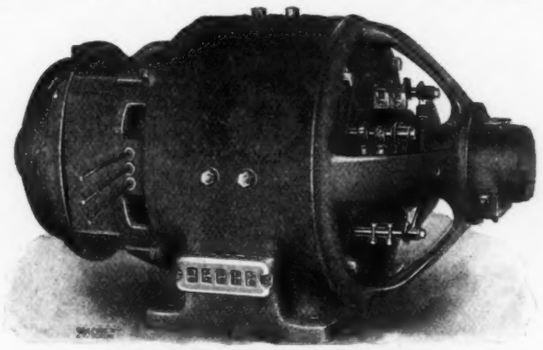
the machine the fresh air passes through a very fine wire-cloth screen, to remove all dust and dirt. This screen may be taken out and cleaned. The fresh air enters the room from the top of the machine in an upward current, thus avoiding all draughts. The front of the machine is a door, which when opened, allows access to the motor, oil cup and speed controller. The motor is of a slow-speed type, direct connected, and designed especially for this machine, with a view of making it practically noiseless in operation. The device is built by the Garner Ventilating Company, 140 Liberty Street, New York.

BATTERY CHARGING SET.

The number of homes where electricity is a stranger is rapidly decreasing. It is so easy and natural to throw a switch and let electricity do the rest that its use must follow wherever it is available. Small motors designed so that they may be used on the standard lighting and power circuits have greatly lessened the tasks of housekeeping and added many conveniences to the home, operating sewing machines, ice-cream freezers, grindstones, pumps, washing machines, etc.

There are certain cases where the electricity of the lighting circuit cannot be applied directly, as for instance alternating current to charge storage batteries for the operation of automobiles, electric launches, telegraph instruments, etc. To meet the requirements of this service the General Electric Company manufactures the motor-generator set illustrated herewith.

The generator voltage may be anything between 60 volts and 125 volts, by means of a controlling rheostat which is a part of the equipment of the set. To meet all conditions of installation the generator may be driven by a direct-current motor designed

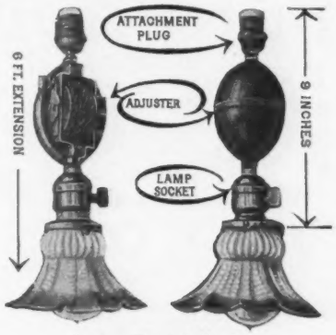


Battery Charging Set.

for 230 volts or 550 volts; by a polyphase alternating-current motor designed for 110 volts, 220 volts, 440 volts or 550 volts, 60 cycles; or by a single-phase alternating-current motor designed for 110 volts or 220 volts, 60 cycles. The set may be mounted on the floor, wall, or ceiling, whichever way may be most convenient or occupy the least valuable space. Its operation is so simple that anyone can use it by following instructions. The installation of such a set enables one to charge batteries at any time on his own premises and avoids annoying delays.

LAMP CORD ADJUSTER.

The accompanying illustration shows a lamp cord adjuster wired complete and ready for attachment to any socket. The lamp cord passes through the adjuster and is wrapped around a wooden spool which is actuated by a steel spring so that the cord length is automatically shortened when the spring is released by touching the button at the side of the metal cover. The cord is lengthened by simply pulling against the resistance of the spring. Where it is desired to lengthen the cord before the adjuster is attached to the fixture, both ends of the cord are pulled simultaneously and when the cord is pulled out to its full length, the adjuster is slipped to a position on the cord which will allow it to meet the lamp socket when the lamp is raised to its highest position. The device is readily rewired. A U-spring inside the cover holds the two halves neatly together, and by pressing on its end projections, the spring is released and the cover pulled apart. The old cord can then be removed and the main spring wound up by holding the adjuster



Lamp Cord Adjuster.

in one hand and turning the wooden spool on which the cord is wound with the other hand until the spring is wound up tightly. The lamp cord can then be threaded through the bushings and the hole in the spool whence the rachet can be released and the spring permitted to wind the cord up slowly. Afterwards the cover may be replaced. The device is simple and substantial in its mechanism, and handsome in appearance. The adjuster is furnished with 6 ft. of lamp cord and the mechanism is enclosed in a cold-drawn metal cover finished in polished brass, brushed brass, oxidized copper or nickel. The adjuster is easily operated by one hand and the lamp may be quickly lowered or raised without any surplus cord being in evidence. The Hagstrom Brothers' Manufacturing Company, of Lindsborg, Kan., is the manufacturer of the device.

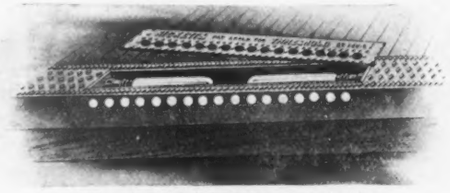
ILLUMINATED ELEVATOR THRESHOLD.

The manager of a large office building has devised an illuminated elevator threshold which indicates to one entering the car the exact position of the elevator floor, thus avoiding the danger of injury from stumbling or falling when the elevator is not in alignment with the floor of the story at which the car is stopped.

The device consists of a cast metal plate containing glass lenses in both its upper and outer surfaces, which are illuminated by two bung-hole type incandescent lamps contained inside the hollow box.

This illuminated threshold can be easily installed, as shown in the accompanying illustration, it being necessary to remove only a small portion of the floor of the elevator for this purpose. The lamps burn continuously while the car is in operation, and are supplied through the elevator cable from the same circuit as the overhead lamps. The device is substantially constructed and will withstand without damage the impact or weight of any heavy furniture or safes which may be carried in the elevator.

It is well known that the majority of accidents in elevators happen through carelessness on the part of the operator or



Illuminated Elevator Threshold.

passenger when the latter is entering the car, and it is believed that this simple apparatus, which provides an illuminated warning of the exact position of the elevator floor, will avoid many possible accidents and injuries with their accompanying expensive damage suits. The device requires no other attention than the renewal of the lamps as they become burned out. The Ricketts illuminated threshold for elevators is manufactured by the Illuminated Elevator Threshold Company, 408 Olive Street, St. Louis, Mo.

Industrial and Commercial News

The Week in Trade.

BETTER weather and the advance of the spring season have done a great deal to help along general commercial conditions within the past week. An additional stimulus is always given to retail trade by the near approach of Easter, and all of these together have done much to make active business throughout the country. From every section retailers are now reporting an excellent spring business. This is being reflected in the orders that are being received by wholesalers and jobbers, which are better than they have been for the past two months. It is true that a large portion of this business is in the shape of re-orders, but this of itself indicates that the consumers are buying freely. The main conservatism in wholesale lines at the present time is in cotton goods, and this, as has before been pointed out, is largely due to the uncertainty of prices for raw cotton. Under the present conditions manufacturers, wholesalers and retailers are all afraid to invest heavily. The good weather has also largely stimulated out-door construction work, and the building trades are reporting a considerable addition to their orders. In the industrial world business has also somewhat improved, due to the collapse of the general strike in Philadelphia, and the prospect of a settlement of the wage question upon the Western railroads. The sky, however, is not entirely clear, for some of the Eastern railroads still have wage schedules to settle and the soft-coal miners are dissatisfied with their present condition. There has been an exceedingly heavy trade throughout the spring in agricultural implements and in fertilizers, and this indicates that farming operations will be carried on upon a larger scale than ever. High commodity prices are still a disturbing element in the general commercial situation, and there seems to be no indication of any reduction. Collections, while still somewhat irregular, have very materially improved, and the money situation throughout the West is satisfactory. Business failures for the week ended March 24, as reported by *Bradstreet's*, were 231, as against 208 the previous week, 226 in the same week of 1909, 286 in 1908, 166 in 1907, and 169 in 1906.

The Copper Market

COPPER statistics for the month of March in a measure explain the weakness of the copper market. It is estimated that the production for the month will be in the neighborhood of 125,000,000 lb. It is known that the domestic consumers are not melting more than 60,000,000 lb., and it is not believed that the exports will run much above 40,000,000 lb. These figures indicate a considerable increase in the surplus stocks at the end of the month. Another important development, which is tending to complicate the situation, is the fact that imports have increased rather heavily within the last few weeks. Japan, South America and Mexico are all sending copper to this market, and indications are that the arrivals in March will be between 12,000 and 14,000 tons. Business during the past week has been dull, and in standard and electrolytic copper the purchases have been unimportant. This is true both in the domestic market and in the London market. The speculative interest at the latter center is for the time being taking no part in the market. This is probably due to the advance in discount rates abroad, making the carrying of copper more precarious. Domestic consumers are known to be amply supplied for their immediate needs and are of the opinion in many instances that lower prices will prevail later on. Exports for March, including March 28, were 16,212 tons. Standard copper, March 28, was quoted as per the accompanying table.

	Bid.	Asked.	Selling price.
Spot	12.75	13.05	.....
February	12.75	13.05	12.90
March	12.75	13.05	12.90

The London market being closed the following are the prices quoted the last day of trading, March 24:

	Noon. £ s d	Close. £ s d
Standard copper, spot	58 15 0	58 15 0
Standard copper, futures	59 17 6	59 17 6

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.50c.	12.95c.
London, spot	£62 0 0	£58 15 0
London, futures	62 18 9	59 15 0
London, best selected	65 10 0	62 15 0

Commercial and Industrial Notes.

High Rubber and the Price of Insulated Wire.—The important manufacturers of insulated wire are having a hard time making prices under the present conditions of the rubber market. For many months crude rubber has been advancing until at the present time prices are more than twice as high as they were a year ago. Up-river Para is now selling for about $2.50 per pound, green, and Africans and Centrals are equally high. There has been an advance within the past fortnight in the London market and there is no indication that there will be any recession. The effect of this has been to make those brands of insulated wire that require any amount of first-class rubber for covering advance to a considerable extent. Speaking of the condition of the trade, the manager of one of the largest manufacturing concerns in the country had this to say: "The high price of rubber, while it will work hardship on some of our customers and may curtail business, is still a benefit, as I regard it. For several years the insulated wire trade has been plagued by numerous small and irresponsible manufacturers, who have made poor stuff and claiming that it was all right have been able to undersell us. It has been useless to attempt to show that the insulation on these goods was worthless and that the whole structure went to pieces after a little handling. Now that the price of rubber and of all of the compounds that are used as substitutes have been advanced the makers of this inferior stuff find themselves in a quandary. They must either advance their prices or must make more inferior goods. The majority of them have done business entirely on the cheapness of their wares, and under the present condition they must advance prices or make their goods plainly worthless. The old line guaranteed manufacturers have had to advance their prices to some extent, but not enough to seriously interfere with trade. Then, again, the high price of rubber is educating the users of insulated wire to the true situation. They are beginning to understand that it would be impossible for certain manufacturers to sell wire with a 30 per cent rubber compound insulation at a price that would hardly pay for the rubber contained in the insulation. I cite this condition because I saw that very thing done a few weeks ago. An offer of insulated wire was made with the statement that it was of a certain grade at a price that would not pay for the insulation if the grade was what it was represented to be. My hope is that the high prices will freeze out the makers of inferior stuff and that in the end we shall have a standard of quality we have never had before."

To Enlarge General Electric Plant.—The General Electric Company announces that it is now ready to carry out the plans, formed some time ago, for enlarging the Stanley plant at Pittsfield, Mass. About $500,000 in all will be spent on the improvement. Three contracts for buildings have already been let, involving an expenditure of $200,000. These are for an annealing building, 120 x 80 ft.; a pattern storage building, 160 x 80 ft. four stories and an addition to the power plant that will double the capacity. In addition the company has plans for a punch press building 375 x 120 ft. and a four-story building 600 x 80 for manufacturing and storage purposes. All of the buildings will be of steel and brick construction, and will be finished within a year. An official of the General Electric, in speaking of these improvements, said that they were made necessary because the company had concentrated its transformer building in Pittsfield and all of the engineers connected with this department have been located there. The large growth in the demand for heating appliances, wihch are principally made in the Stanley works, also requires more factory space.

Rateau-Smoot Low-Pressure Turbines for Maryland Steel Company.—The Ball & Wood Company has received an order from the Maryland Steel Company for its Sparrow Point plant for two 750-kw Rateau-Smoot low-pressure turbines and 250-volt generators, to be operated on exhaust steam from blowing engines.

Mexican Rubber.—The price of the guayule rubber shrub has advanced at Torreon, Mexico, to $90 gold per ton, and it is claimed by well informed buyers that the product will probably go to more than $100 gold per ton in a short time. The guayule rubber factories in Torreon and at other places in Northern Mexico are busy, most of them running day and night. A few years ago, soon after the discovery was made that a good grade of rubber could be made from the guayule shrub, the price paid for it was $17.50 gold per ton. The demand for the crude rubber product has increased very rapidly in the United States and Europe, where it is extensively used in the manufacture of automobile tires and for electrical purposes. The industry is now practically in control of two or three large interests, the most extensive operator in the new field being a subsidiary concern of the United States Rubber Company. The monthly exportation of the unrefined guayule rubber from the Torreon district alone now aggregates more than $1,000,000 gold in value. It is, next to the mines, the largest industry in Northern Mexico. The territory in which the guayule shrub grows is limited in area, being confined to the more altitudinous parts of the States of Coahuila, Durango and Zacatecas. Since the price of the shrub has increased to such a fancy figure there is great activity on the part of speculators to acquire by purchase or lease lands upon which it is growing. These lands were formerly considered practically worthless, their market value ranging from 5 cents to 15 cents gold per acre. Now that the enormous value of the once despised guayule shrub is established, the same lands sell readily for $12.50 to $50 gold per acre, the price depending upon the probable yield of the wild shrub. The propagation of the shrub by means of the seed and from the roots is being extensively carried on in many localities by the owners of rubber factories.

Irrigation Development in Idaho.—Post Falls Irrigation Company, composed of Chicago capitalists, represented by Trowbridge, Niver & Company, has completed plans to put 3,500 acres of apple, pear and berry lands under the ditch at Post Falls, Idaho, 24 miles east of Spokane, the cost of the project being estimated at $500,000. James Stephenson, Jr., State engineer of Idaho, and consulting engineer for the Chicago bonding house, designed the scheme for the distribution of water, and the plant will be constructed under the direction of Edward Hedden, for years identified with the United States reclamation service. The electrical pumping apparatus will be installed by J. B. Ingersoll, chief engineer of the Spokane & Inland Empire Electric Railway system, whose lines pass through the tract. Water will be taken from Hayden lake in the heart of the north Idaho forest reserve. The plant is to be completed within 90 days. A complete double pumping plant, electrically equipped, consisting of two motors, two centrifugal pumps, with a capacity of 18,000 gallons a minute, will be installed. This plant will pump water through a 42-inch pipe line, underground, a distance of four miles, to a point where the water will be distributed by gravity over the tract, which is platted.

Baltimore Water & Electric Company.—Stockholders of the Baltimore County Water & Electric Company have authorized an increase in the capital stock of the company from $300,000 to $600,000, as recommended by the board of directors. The plan of the company in issuing additional stock is to provide it with a larger working capital and to take care of the improvements which the company might want to make in the near future. Recently the company has been improving its service in the county and extending it to sections which had no facilities for securing water. A new reservoir has just been constructed at Towson at a cost of several thousand dollars, and a sterilizing plant is now being installed at Highlandtown and Canton.

Westinghouse Turbine and Gas Engine.—The Pullman Company, of Pullman, Ill., has ordered two 1000-kw Westinghouse high-pressure steam turbines, together with a Westinghouse-Leblanc condenser equipment. The Lumberman's Portland Cement Company, of Carlisle, Kan., has installed two Westinghouse gas engines of 300 hp and 140 hp, respectively, in its new brick plant at Carlisle. The engines will be supplied by natural gas from the company's wells, and will be direct-connected to Westinghouse three-phase, 25-cycle, 440-volt generators, which will supply power for driving brick-making machinery.

Denver Theater Wiring.—The contract for electric wiring in the new White City Theater, of Denver, has been let by the architects, Wagner & Manning, to H. L. Webber & Company, of Denver. The installation includes the heaviest stage lighting equipment in Denver, though it is a summer theater. There are six borders, each consisting of 30 32-cp whites, 15 32-cp reds and 15 32-cp blues, and the same equipment for the footlights. The installation is all conduit, and the contractor is required to furnish a certificate of approval from the underwriters having jurisdiction. The seating capacity of the theater is 1700.

Montreal's Underground Project.—W. G. Ross, president of the Montreal Street Railway Company, has announced that his company intends to build an underground railway system as soon as the necessary legislative authority can be obtained. He says that plans have been prepared for lines aggregating 14 miles. This project was discussed in January in connection with a proposed consolidation of the traction company with the Montreal Light, Heat & Power Company into a $100,000,000 corporation. About the first of March the Montreal Elevated & Underground Railway Company was organized with an authorized capital of $20,000,000.

General Electric Turbines for Los Angeles.—The Pacific Light & Power Company, of Los Angeles, has ordered from the General Electric Company two 12,000-kw Curtis vertical steam turbine generators and one horizontal 100-kw Curtis turbine exciter set. These machines will be installed in the company's Redondo plant, in which there are now installed three 5000-kw units driven by reciprocating engines. The turbines will be placed in the end of the building now occupied by circulating pumps and auxiliaries.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Opelika, Ala.; San Diego, Cal.; Carson City, Nev.; Texas City, Tex.; Fort Lupton, Col.; Nephi, Col.; Fort Terry, N. Y.; Green Cove, Fla.; Fort Barrancas, Fla.; Columbia, Mo.; Eustis, Fla.; Los Angeles, Cal.; Otisville, N. Y.; Cordelle, Ga.; Forest Grove, Ore.; Syracuse, Kan.; Albion, N. Y.; Erie, Pa.; Buffalo, N. Y.; Chicago, Ill., and Denmark, S. C.

Tri-State Telegraph & Telephone Company.—The property of the Southwestern Telephone & Telegraph Company, of El Paso, Tex., including lines in New Mexico and Arizona, has been purchased by the Tri-State Telegraph & Telephone Company, a Colorado corporation, capitalized at $1,000,000, with headquarters at Colorado Springs. It is said that the purchasing company intends to build lines to Denver, Douglas, Bisbee and Globe, and will spend about $300,000.

West African $1,000,000 Projected Hydroelectric Plant.—The Lobito, Benguella & Catumbella Electric Light and Power Company has organized to construct a hydroelectric plant and distribution system to supply the chief towns of Angola Colony, Benguella, Providence and Portuguese Southwest Africa Bonds and stock to the amount of £175,000 have been placed on the market.

Electro-Magnetic Tool Company.—The Electro-Magnetic Tool Company, with office and factory at 115 South Clinton street, Chicago, has been reorganized, acquiring the interests of the Carthage & Western Illinois Electric Company. The officers and directors of the company remain the same as before. As the name indicates, the company manufactures electro-magnetic tools and devices, including an electric hammer.

Economy Light & Power Company.—Negotiations have been completed by the Economy Light & Power Company, of Joliet, Ill., for the purchase of the property and rights of the Illinois Light & Power Company, of Streator, Ill. This is one step in the plan of the Economy company to extend its service to Streator, Ottawa, Dwight, Morris and several other towns in this vicinity.

General Electric Car Equipments.—The General Electric Company has just sold to the Hudson & Manhattan Railroad Company 50 two-motor car equipments for the 50 new steel cars recently ordered by that company from the American Car & Foundry Company. These equipments are of special design and are the same type as those installed on 90 steel cars last fall.

Montreal Railroad Electrification.—Large blocks of property are said to have been purchased for the Montreal railroad terminal. It is reported that the Canadian Northern will join with the Canadian Pacific in building the terminal. It is planned to use electric locomotives exclusively in the terminal tunnels.

Building Monorail Line.—Construction work upon the monorail traction line between Bartow Station, on the New Haven railroad, and City Island is being pushed forward rapidly. Bion L. Burrows, the chief engineer of the Monoroad Construction Company, which is building the road, says that about 65 per cent of the grading and earthwork is already done, and that he hopes to have the road in operation some time during the summer. There was some delay in starting the project, owing to a hitch in the financial arrangements of the company. As the Public Service Commission declined to permit the issue of bonds it was necessary to raise funds by other means. This has now been successfully done, and the project has all the money needed for construction work. Among those who are interested in the project and lending it support are August Belmont, E. R. Chapman, Captain Charles F. Holm and R. H. McCarter. The road will be three miles long, one-half of it being through Pelham Bay Park. Upon this section of the road it is expected to demonstrate the possibilities of the system for high speed. The road itself is being built experimentally to show the value of monorail construction for traction companies.

Financial

THE WEEK IN WALL STREET.

THE Wall Street market approached its two days holiday in a very unsettled state of mind. During the days immediately preceding the Easter adjournment, trading was light and prices exceedingly irregular, although fluctuations were not extensive. There seems to be a confusion and uncertainty that has kept outsiders away from the market, and is causing the professionals to be unusually careful. No trader appears to be willing to make any large commitments. The copper shares were especially weak, and one of the least resisting issues on the list was the common stock of the Westinghouse Electric & Manufacturing Company. Without any assignable cause, further than the general talk which has spread over the Street for the past few weeks concerning disagreements in the management of the company, this stock was freely offered for sale, and on March 28 recorded a net loss of 5¼ points. Although the rumors of internal trouble are denied, and the business of the company is reported to be entirely satisfactory, the stock in Wall Street has been weak for more than a month. There has been little change in the money market, and rates are still easy. On March 28 call money was quoted at 2½@3 per cent; 90 days, 4@4¼ per cent. The quotations in the table are those of the close, March 28.

NEW YORK.

	Mar. 21.	Mar. 28.	Shares sold.		Mar. 21.	Mar. 28.	Shares sold.
All.-Ch.	11⅞	9⅞	2,000	Int.-Met., pfd.	58¼	56¾	57,200
All.-Ch., pfd.	44	39*	3,300	Mackay Cos.	89	89½	200
Amal. Cop.	78½	74½	89,400	Mackay C., p.	77*	77	300
Am. D. T.	20½*	20½*	——	Man. Elev.	136*	137*	427
Am. Loc.	52	49	1,920	Met. St. Ry.	16*	16*	——
Am. Loc., pfd.	114*	113*	300	N.Y.&N.J.Tel.	139¼*	139¼*	——
Am. Tel. & C.	75*	75*	——	Steel, com.	85¾	83	359,750
Am. T. & T.	140¾	140⅛	6,335	Steel, pfd.	121	119½	4,487
B. R. T.	76⅜	76	43,470	W. U. T.	75	73⅛	660
Gen. Elec.	154¼	151	1,500	West'h., com.	70	63¼	2,100
Int.-Met., com.	22⅝	22¼	62,400	West'h., pfd.	125*	125	——

PHILADELPHIA.

	Mar. 21.	Mar. 28.		Mar. 21.	Mar. 28.
Am. Rys.	45	45*	Phila. Elec.	16¼	16
Elec. Co. of A.	12*	12*	Phila. R. T.	22⅞	21⅛
Elec. St. B'ty	62⅞	60½	Phila. Trac.	87	87
E. S. B'ty, pfd.	30*	30*	Union Trac.	50⅛	49

CHICAGO.

	Mar. 21.	Mar. 28.		Mar. 21.	Mar. 28.
Chi. City. Ry.	185*	185*	Chi. Tel. Co.	132½	132
Chi. Rs., Ser. 1	106*	106*	Met. El., com.	16*	16*
Chi. Rs., Ser. 2	31½*	32*	Met. El., pfd.	53*	51
Com. Edi on.	116⅞	116⅞	Nat'l Carbon.	112½*	114¼
Chi. Subways	3*	3*	Nat'l Car., pfd.	120¼*	120¼*

BOSTON.

	Mar. 21.	Mar. 28.		Mar. 21.	Mar. 28.
Am. T & T.	141	140¼	Mex. Tel.	4⅝	4⅞
Cum. Tel.	152*	152½*	Mex. Tel., pfd.	7*	6½
Edison E., Ill.	254½	256½	N. E. Tel.	137½	137½
Gen. Elec.	156	149¾	W. T. & T.	16¾	16½*
Mass. E. Ry.	17	17¾	W. T. & T., pfd.	88¼	89*
Mass. E. R., pfd.	84*	84			

* Last price quoted.
Shares sold are for week of March 21 to March 24.

FINANCIAL NOTES.

Michigan Power Merger Will Be Postponed.—The plan being negotiated by Hodenpyl, Walbridge & Company, of New York, and E. W. Clark & Company, of Philadelphia, for the merging of 10 water-power plants in Michigan into one organization to be known as the Consumers Power Company, has been temporarily abandoned owing to the refusal of the State Railway Commission to approve the financial plans proposed. The company asked for authority to issue $10,000,000 of prefered stock, $10,000,000 of common stock and $36,000,000 in bonds. This request has been refused by the commission unless a definite inventory could be made of the value of the various plants that are to be merged. There was not time for a special appraisal to be made, although an effort in this direction was started. The pooling agreement of the stock of the properties, which was the basis upon which the merger was being negotiated, expires April 1. At the office of Hodenpyl, Walbridge & Company, in this city, it is said that the consolidation has in no manner been abandoned, but that owing to the shortness of time it has been impossible to secure the proper authority for financing. The consolidation will eventually be made, according to this authority.

Consolidated Gas Tax Dispute Settled.—After many years of bickering and hundreds of conferences, the dispute between the City of New York and the Consolidated Gas Company, involving the electric companies, has been settled by agreement. There will be an exchange of checks whereby the companies will pay to the city about $7,000,000 for back taxes and the city will pay to the companies about $6,000,000 for unpaid lighting bills. The Mayor also insisted, before he would agree to the settlement, that the companies should pay to the city $585,000 personal taxes. The settlement was made on the basis of an assessment for franchise taxes of nearly $10,000,000 more than the basis of compromise suggested by the companies two years ago.

Otis Elevator Debentures.—Blair & Company, New York, have underwritten the recent issue of $3,500,000 ten-year debenture 5 per cent bonds of the Otis Elevator Company. These bonds are convertible into common stock at par, after April 1, 1913, and to take care of this conversion the capital stock of the company has been increased from $6,500,000 to $10,000,000. The company's floating debt will be paid off with the proceeds of these bonds, and the company has agreed to maintain cash assets in excess of the amount of the bonds as long as they are alive. The stockholders have been given the right to subscribe for the new issue at 97½.

Union Light, Heat & Power Company.—Louis J. Hauck and N. S. Keith have retired from the board of directors of the Union Heat Light & Power Company, of Covington, Ky., and R. W. White, William T. Hunter, F. B. Enslow and Norman G. Kenan have been added. The other members are A. S. White, J. C. Ernst and J. M. Hutton. The board has thus been increased from five to seven members. J. C. Ernst will be elected president and Albert Silva secretary. The property of the company is under lease to the Columbia Gas & Electric Company.

Penn Light & Power Company.—The Penn Light & Power Company, of Altoona, Pa., has secured control of the Tyrone electric plant, Huntingdon Gas Company, Lewistown Electric Railway & Gas Company and the Juniata Water & Water Power Company. This is in connection with the two local plants at Altoona which were absorbed. The headquarters of the consolidated company will be located at Altoona.

New York State Railways Financing.—The Public Service Commission of the Second District of New York has authorized the New York State Railways Company, of Rochester, to increase its capital stock from $23,140,200 to $23,860,200. The additional stock is to be used for the purchase of the Rochester & Suburban Railway Company and of the Rochester & Electric Railway Company.

Municipal Traction in Detroit.—A petition bearing the signatures of 18,759 voters has been submitted to the City Council of Detroit, calling for a popular vote on the question of municipal ownership of the street railway system. Under the law, when 14,200 names are signed to a petition the Council is compelled to submit the proposition to the voters.

Electric Bond & Share Company.—The Electric Bond & Share Company will, it is reported, take over the Northwest Corporation, which has a number of plants in Northern California, Oregon and Idaho, valued at $10,000,000.

Pullman Company Stock Increase.—The Pullman Company of Chicago has been authorized by the Secretary of State of Illinois to increase its capital stock from $100,000,000 to $120,000,000.

Allis-Chalmers Company Stock.—During the past fortnight there has been a very marked decline in the price of the stock of the Allis-Chalmers Company in the Wall Street market. This has been especially noticeable with regard to the preferred. Transactions have been large, and there has been evidence of considerable selling pressure. On March 24 the preferred shares sold as low as 36½, the price on Jan. 5 being 54¾; the common stock on the same date was sold as low as 9¾, while on Jan. 3 it sold as high as 15. Accompanying this activity and decline there were numerous rumors in Wall Street that the Allis-Chalmers Company was about to issue new securities in order to raise necessary funds. At the office of the company Vice-President W. W. Nichols said that this rumor was entirely without foundation; that the company had put through a financial plan just before the panic of 1907, when the present issue of $10,300,000 first mortgage sinking fund bonds was made, and at the present time it needed no additional financing; and that its business is entirely satisfactory. Up to date the business for 1910 has exceeded by 40 per cent the same period for 1909. Much of this increase has been in small orders, which he regards as more profitable and as furnishing quicker returns. A telegram received at the New York office from W. H. Whiteside, president of the company, said: "All lines this month show a marked improvement in the business situation. We have now on hand very important negotiations for many large gasoline engines, and have just secured four contracts for large steam-turbine plants in New England, together with several gas-engine plants."

Bristol Gas & Electric Company.—White & Company, bankers, of New York, are offering to the public $425,000 of 5 per cent bonds of the Bristol (Va.-Tenn.) Gas & Electric Company. These bonds are offered at 96 and interest. The company owns all of the gas and electric properties in the twin cities of Bristol, Va., and Bristol, Tenn., and controls the street railway system, through the ownership of the entire capital stock, which is held in the treasury as an asset. The population served is about 23,000.

Improvement in Utility Earnings.—That there has been a vast improvement in the earnings of public utility companies is shown by the compilation of figures made by the *Wall Street Summary*. This paper has taken the reports for January of 21 companies of considerable size, both traction and lighting enterprises, and compared the earnings with those of January, 1909. The result shows an increase in gross equal to 13.19 per cent; in operating expenses, 7.98 per cent, and in net earnings 19.12 per cent.

DIVIDENDS.

American Locomotive Company, preferred, quarterly, 1¾ per cent, payable April 21.

Associated Gas & Electric Company, preferred, quarterly, 1½ per cent, payable April 15.

Bell Telephone Company of Missouri, quarterly, 2 per cent, payable April 1.

Bell Telephone Company, of Pennsylvania, quarterly, 1½ per cent, payable April 15.

Central & South American Telegraph Company, quarterly, 1½ per cent, payable April 8.

Chattanooga Railway & Light Company, preferred, quarterly, 1¼ per cent, payable April 1.

Cincinnati & Hamilton Traction Company, preferred, quarterly, 1¼ per cent; common, ⅝ per cent, payable April 1.

Columbus (Ohio), Newark & Zanesville Electric Railway Company, $1.50 per share, payable April 1.

Electric Storage Battery Company, quarterly, preferred and common, 1 per cent each, payable April 1.

Fort Smith (Ark.) Light & Traction Company, preferred, quarterly, 1¼ per cent, payable April 15.

Gamewell Fire Alarm Company, quarterly, 1¼ per cent, payable April 1.

Houghton County (Mich.) Electric Light Company, semi-annual, preferred, 3 per cent; common, 2½, payable May 2.

Mexican Telephone & Telegraph Company, preferred, semi-annual, 2½ per cent, payable May 1.

National Carbon Company, common, quarterly, 1½ per cent, payable April 15.

Northwestern Elevated Company, Chicago, preferred, 1 per cent, payable April 18.

Oklahoma Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable April 10.

Ottumwa (Iowa) Railway & Light Company, preferred, quarterly, 1¾ per cent, payable April 15.

San Diego Consolidated Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable April 15.

Shawinigan Water & Power Company, quarterly, 1 per cent, payable April 20.

Syracuse Rapid Transit Company, preferred, quarterly, 1½ per cent, payable April 1.

United Traction Company of Indiana, preferred, semi-annual, 2½ per cent, payable April 1.

Washington Water Power Company, Spokane, quarterly, 1¾ per cent, payable April 1.

Westinghouse Electric & Manufacturing Company, preferred, 1¾ per cent. payable April 15.

REPORTS OF EARNINGS.

	Gross. earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Allegheny Valley Railway Company:					
Year 1909	$6,454,825	$4,477,779	$1,977,046	$1,224,568	$752,478
Year 1908	5,618,128	4,368,945	1,249,183	1,228,578	20,605
American District Telegraph Company of New Jersey:					
Year 1909	3,638,928	2,756,779	882,149	398,496	483,653
Year 1908	3,221,727	2,435,845	785,882	398,088	387,794
American Telephone & Telegraph Company:					
January, 1910	13,384,795	4,845,356	8,539,437	4,997,853	3,541,584
January, 1909	12,076,510	4,578,041	7,498,469	4,565,591	2,933,878
Central & South American Telegraph Company:					
Year 1909	1,665,029	667,983	997,046	574,260	422,786
Year 1908	1,664,506	677,160	987,346	574,260	413,086
Duluth-Superior Traction Company:					
Year 1909	997,606	559,811	137,795	172,366	265,429
Year 1908	892,638	551,780	340,858	159,201	181,657
East St. Louis & Suburban Railway Company:					
February, 1910	175,234	94,765	80,469	49,602	30,867
February, 1909	148,833	83,343	65,490	49,235	16,255
Lake Shore Electric Railway System:					
February, 1910	70,876	47,275	23,601	34,847	11,246
February, 1909	60,471	44,019	16,452	34,520	18,068
Mexican Telegraph Company:					
Year 1909	848,597	273,461	575,136	340,942	234,194
Year 1908	811,342	199,710	611,623	287,010	324,613
Montreal Street Railway Company:					
February, 1910	303,977	204,255	99,722	39,875	59,846
February, 1909	284,090	196,912	87,178	35,037	52,141
Nashville Railway & Light Company:					
February, 1910	136,489	76,417	60,022	48,200	11,822
February, 1909	131,313	76,514	54,799	46,816	7,983
Northern Ohio Traction & Light Company:					
February, 1910	146,206	92,513	53,693	43,291	10,402
February, 1909	136,504	80,542	55,962	43,780	12,182
Otis Elevator Company:					
Year 1909	.....	.....	1,048,689	378,600	670,089
Year 1908	.....	.....	832,772	378,375	454,397
Philadelphia Company:					
February, 1910	1,795,422	901,752	893,670	.....	.....
February, 1909	1,525,430	713,180	812,250	.....	.....
Sao Paulo Tramway Light & Power Company:					
February, 1910	215,624	77,486	138,138	.....	.....
February, 1909	200,405	68,425	131,980	.....	.....
United States Telephone Company:					
Year 1909	433,081	243,471	189,610	107,800	106,858
Year 1908	444,849	197,547	247,302	107,800	167,185
United Traction Company of Albany:					
Quarter ended Dec. 31, 1909	537,801	327,193	210,608	94,621	137,722
Quarter ended Dec. 31, 1908	484,225	303,869	180,356	69,643	116,188

General News

Construction News.

GADSDEN, ALA.—Preparations are being made by the Alabama Railway & Power Company for the construction of a water tower on Town Creek, about 30 miles from Gadsden. It is estimated that 15,000 hp can be developed, which will be transmitted by electricity to this city.

OPELIKA, ALA.—J. B. McCrary & Company, engineers, of Atlanta, Ga., have been engaged to prepare plans for the proposed municipal electric light plant and water works in Opelika, bids for construction of which will be received until April 15. L. F. Dickson is Mayor.

SAFFORD, ARIZ.—A special election will soon be called to vote on the proposition to establish a municipal electric light plant and water works system.

AFGENTA, ARK.—The Little Rock Telephone Company has commenced work on improvements to its local system, which will involve an expenditure of about $200,000, and include new exchange equipment throughout and installation of cables. B. F. Kendrick is general manager.

COALINGA, CAL.—C. L. Morrill has been granted a franchise by the Town Council to construct an electric railway in Coalinga, six miles in length. It is proposed to extend the railway 15 miles beyond Coalinga, north and east into the oil territory.

DIXON, CAL.—E. D. N. Lehe has been awarded a franchise to erect and maintain transmission lines for the distribution of electricity for lamps and motors in Dixon, for which he paid the sum of $50.

FORT BRAGG, CAL.—The Union Lumber Company has purchased a 1000-kw Westinghouse-Parsons turbo-generator set, together with switchboard, exciter and condenser, of Hunt, Mirk & Company, San Francisco, Cal. The equipment will be installed in the company's plant at Fort Bragg.

FRESNO, CAL.—A certificate has been filed showing the creation of bonded indebtedness of $2,000,000 by the Coalinga Water & Electric Company. The funds are to be used for locating an electric light and water plant in Coalinga, and it is probable that the proposed railroad to the California Limited oil wells, in the Coalinga oil fields may secure its motive power from this source. The directors of the company are: W. S. Kerchoff, A. C. Balch, A. G. Wishon, A. Haas and Kaspare Cohn.

LA GRANGE, CAL.—The Board of Supervisors has refused to grant the La Grande Light & Power Company the franchise applied for, giving its permission to erect transmission lines over the country, claiming it would give the company a monopoly in the county.

LOS ANGELES, CAL.—Plans are being considered for the illumination of Seventh Street, from Boyle Avenue on the east to Hoover Street on the west, a distance of over four miles. It is proposed to widen the thoroughfare and install about 4200 lamps. The cost of the lamps is estimated at $50,000.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has purchased the franchise to construct an electric railway on South Garey Avenue, Franklin Avenue and East Fifth Avenue from Gary Avenue to the city limits. Under the terms of the franchise the company is to have cars operating within six months.

LOS ANGELES, CAL.—A. B. Shiver has sold 108 acres in West Hollywood to A. S. Spaulding, who heads a syndicate of local capitalists. The land will be subdivided and placed on the market. It is proposed to install an ornamental street lighting system on Sunset Boulevard from Gardner Street, west of Laurel Canyon, which, it is said, is approved by the new owners.

LOS ANGELES, CAL.—Bids will be received until April 18 by the Board of Supervisors for furnishing and installing an electric generating unit, consisting of an engine and generator, at the County Hospital, plans and specifications for which may be seen at the office of Hudson & Munselle, architects, Stimson Building, Los Angeles, Cal.; also at the office of the Board of Supervisors.

McKITTRICK, CAL.—Application has been made to Supervisors of Kern County by H. A. Stantien for a 50-year franchise to erect and operate transmission lines for the distribution of electricity in the Town of McKittrick, bids for which will be received until April 9, 1910.

OROVILLE, CAL.—Two notices of appropriation of water rights have been filed in Butte County. The first by E. S. Mann, of Cohasset, appropriating 1200 ft. of water in Chico Creek, near Cohassett, who, it is said, proposes to divert the water by means of a concrete dam and carry it by ditches and flumes to a point two miles below to what is known as the "Big Feeder," where a power plant is to be located. It is understood that no immediate steps will be taken toward construction of the plant. The second appropriation filed was for 3000 miners in. from the west branch of the Feather River by A. E. Smith, president of the Butte-Magalia Consolidated Mining Company, to be utilized to generate electricity for working the mines of the company. The water is to be carried by a ditch or flume 2000 ft. from the point of diversion.

SAN DIEGO, CAL.—Announcement has been made that the San Diego Gas & Electric Company contemplates extensive improvements and extension to its plant, which will involve an expenditure of about $1,000,000. C. E. Groesbeck is president and manager.

SAN FRANCISCO, CAL.—The Municipal Light & Power Company has awarded a contract to Hunt, Mirk & Company, of San Francisco, Cal., for an additional 1000-kw Westinghouse-Parsons turbo-generator to be installed in its plant in the Claus Spreckels Building annex on Stevenson Street. Orders were also placed with the same firm for Stirling boilers, condensers and cooling plant.

SUTTER CREEK, CAL.—It is reported that the Amador Electric Light & Power Company is contemplating extensive improvements to its system, and will issue bonds to the amount of $75,000.

DENVER, COL.—It is reported that the contract for the construction of the Stove Prairie reservoir, about 40 miles northeast of Greeley, which is to form a part of the Laramie-Poudre irrigation project, will be let in about two weeks. The project will impound 1,500,000,000 cu. ft. of water. The plans include the construction of three power plants, which will furnish electricity in the northern part of Colorado and possibly for the street railway system in Denver. William G. Evans, president of the Denver City Tramway Company, is interested in the project.

FORT LUPTON, COL.—Tiffany & Company, of Denver, Col., have been granted a franchise to construct and operate an electric light plant and water works system in Fort Lupton. Under the terms of the franchise the plants are to be completed within 90 days.

GOLDEN, COL.—Application will be made at the next meeting of the City Council for a franchise to construct and operate an electric railway within the city limits by Rees C. Vidler and associates. It is proposed to operate electric cars from Golden to the foot of the Lookout Mountain, from which a funicular road will be constructed to the top. It is said that the project has been financed and work will commence on construction of the road as soon as the right of way is secured.

HOLYOKE, COL.—The municipal electric light plant in Holyoke is nearly completed. The equipment of the plant includes two 100-hp return tubular boilers, supplying 100-hp engine direct-connected to a 75-kw General Electric, three-phase, 2300-volt generator and a two-panel switchboard made by the General Electric Company.

TRINIDAD, COL.—Work has commenced on construction of the new plant of the DuPont-Nemours Powder Company in Trinidad, Col. An electric power plant will be installed, and a large line of motors for individual drive will be required.

DELAWARE CITY, DEL.—The American Power & Lighting Company is reported to have decided to build a power house to generate electricity instead of securing it from the Delaware Water Improvement Company's plant at New Castle, Del. The proposed plant will be located on the Chesapeake & Delaware Canal, opposite Delaware, at the entrance to the Government Reservation, which is expected to be completed and in operation by the middle of May. The company has a contract with the Government to furnish electricity at the fort and a tentative agreement with the town of Delaware City for street lighting. The cost of the plant is estimated at $30,000, machinery for which has already been ordered. Harry C. Clark, of Delaware City, is reported to be interested in the company.

HARRINGTON, DEL.—The plant and holdings of the Harrington Light, Heat & Power Company, which has been in the receivers hands for some time, was sold March 16 by William M. Hope, receiver, to Solomon L. Sapp and John D. Brown, Commissioners of Harrington, for $520.

WAHINGTON, D. C.—Bids will be received until April 5 at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., to furnish at the navy yards and naval stations the following supplies: Brooklyn, N. Y., Schedule 2337—An electric motor, one switchboard and 1200 ft. weatherproof wire. Schedule 2338—2500 ft. lap-welded steel tubing and 2400 ft. lead pipe. Applications for proposals should designate the schedule desired by number.

BRADENTOWN, FLA.—H. L. Coe, of Bradentown, Fla., is reported to be considering the installation of an electric power plant, the equipment to include a 150-kw unit, exciter, switchboard, etc.

EUSTIS, FLA.—It is reported that the Eustis Water, Light & Power Company will install a water works system, including a 50,000-gal. tank, pumps and accessories. The company will also increase the output of its electric power plant by the installation of a direct-connected unit, consisting of a 125-kw generator and a 200-hp engine.

FORT BARRANCAS, FLA.—Bids will be received by the constructing quartermaster until April 22 for the construction of an electric light system at Fort Barrancas, Fla. Plans and specifications will be furnished upon deposit of $10 to insure return of same. Full information and blanks will be furnished upon application to the constructing quartermaster.

GREEN COVE SPRINGS, FLA.—Bonds to the amount of $45,000 have been sold, the proceeds to be used for construction of municipal electric light plant, water works system and street improvements.

ST. PETERSBURG, FLA.—The Bayboro Investment Company is reported to have commenced work on the construction of its proposed electric railway from Bayboro to St. Petersburg. Snell & Hamlet are reported to be negotiating with the company to secure an extension of the railway from St. Petersburg through the Bay Shore and North Shore subdivisions, two and one-half miles in length.

CORDELE, GA.—Plans have been completed for the erection of the transmission line from the proposed power plant of D. J. Zeigler & Company, now being constructed on the Flint River, to Cordele, Americus and Fitzgerald. The company is building a concrete dam and hydroelectric power plant on the Flint River at a cost of $1,000,000, near Warwick, 10 miles from Cordele, and proposes to furnish electricity to all towns within a radius of 35 or 40 miles of the plant.

LAFAYETTE, GA.—At an election held March 22, the citizens voted to issue $40,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system. C. J. Hammond is recorder.

MACON, GA.—The Macon Railway & Light Company will soon place contracts for the construction of a two-mile extension of its electric railway. J. H. Hertz, of Macon, Ga., is secretary and treasurer.

MILLEDGEVILLE, GA.—The State Railroad Commission has granted the Milledgeville Telephone Company permission to issue $9,000 in bonds, the proceeds to be used for the acquirement of new property and extension of service.

ROME, GA.—Preparations are being made to double the output of the power plant of the Rome Railway & Light Company. Among the improvements contemplated is the installation of a 1000-hp turbine engine.

TIFTON, GA.—The Board of Trade has endorsed the movement to extend and enlarge the rural telephone system in Tift County, Ga., for which a fund has been raised to encourage the work. It is proposed to erect a telephone line on every public road of importance in the county. The Southern Bell Telephone & Telegraph Company is co-operating in this movement. C. L. Parker is chairman of committee.

WAYCROSS, GA.—The Ware County Light & Power Company has awarded the contract for the construction of its power house and gas plant to the Evans Company, of Baltimore, Md. This is said to be the beginning of extensive improvements to be carried out by the Loomis Syndicate, which recently acquired the local system, which it is said will expend about $500,000 for improvements within two years.

CHICAGO, ILL.—Work has commenced on the construction of the new plant of the Linde Air Products Company, of Chicago, Ill., at East Chicago, Ind., which will be equipped for electrical operation. A power plant will be installed, including a battery of boilers, an electric generating unit, etc.

MOLINE, ILL.—The People's Power Company has awarded a contract to the Westinghouse Electric & Maufacturing Company, of Pittsburgh, Pa., for the installation of a new engine and generator in its power house in Moline. The cost of the work is estimated at $250,000. It is understood that Tri Cities and the Northeastern interurban railway companies will secure electricity to operate their lines from the company.

STREATOR, ILL.—Negotiations have been completed for the purchase of the plant and holdings of the Illinois Light & Power Company, which furnishes gas, electrical and street railway service in Streator, Ill., to the Economy Light & Power Company, of Joliet, Ill. It is understood that the Economy Light & Power Company proposes to extend its service to include Streator, Ottawa, Dwight, Morris and other towns in this vicinity.

WARRENSBURG, ILL.—The capital stock of the Warrensburg Telephone Company has been increased from $5,000 to $10,000.

CRAWFORDSVILLE, IND.—Prof. J. W. Esterline, of Purdue, electrical engineer, engaged by the City Council to examine the municipal electric plant, has recommended to the City Council the construction of an entire new plant from the ground up at a cost of not less than $95,000. He also recommends changing the location of the power house, and the installation of luminous arc lamps for street lighting, and 2300-volt, three-phase, 60-cycle power plant equipment. The Council as yet has not taken any action on the matter.

EAST CHICAGO, IND.—The Hubbard Steel Company, of East Chicago, Ind., is reported to be considering the construction of a power plant this spring.

HOPE, IND.—The plant of the Hope Telephone Company, owned by J. W. D. Aspy, it is said, will be taken over by the Morgan interests and operated in connection with the Indianapolis system.

KOKOMO, IND.—The Globe Stove & Range Company, of Kokomo, Ind., has started work on the construction of its new factory buildings, which will double the output of the plant. The addition will be provided with cranes, tramways and other facilities for making castings. The basement will be equipped with motors, blowers, electrical work, etc.

LOGANSPORT, IND.—Mayor D. D. Fickel, Joseph Stewart, superintendent of the municipal electric light plant, and associates are negotiating for the purchase of the Tabor dam in the Wabash River, with a view of improving the dam and constructing a hydroelectric power plant.

MUNCIE, IND.—Arrangements are being made by the Rutherford Brothers, of Muncie, Ind., for the construction of a plant to manufacture lighting fixtures, which it is understood will be equipped for electric motor drive. Electricity for operating the plant may be purchaseed instead of being generated on the premises.

SEYMOUR, IND.—The Seymour Home Telephone Company has closed its exchange and turned over its business to the Mutual Telephone Company.

BELKNAP, IA.—The local telephone company has decided to extend its service and will erect a direct telephone line to Floris and also to Drakeville. The company will also purchase a new switchboard.

HAMPTON, IA.—The Hampton Canning Company, it is reported, is planning to construct and equip four factory buildings, contracts for which will be awarded about April 15. The equipment required will include boilers, electric generators, engines, motors, elevators, sprinkler systems, canning machinery, etc.

SIOUX CITY, IA.—The Sergeants Bluff Telephone Company has changed its name to the Woodbury County Telephone Company and increased its capital stock to $100,000.

WATERLOO, IA.—Plans are being considered by the Waterloo, Cedar Falls & Northern Railway Company to extend its railway from Denver Junction to Waverly, and from Waterloo to Belle Plaine.

ALTAMONT, KAN.—The Kansas Union Traction Company expects to commence work April 1 on the construction of its proposed electric railway, which will extend from Parsons, Altamont, Edna, Valeda and Coffeyville, a distance of 40 miles. Barney McDaniel, of Altamont, Kan., is secretary.

SYRACUSE, KAN.—At an election held recently the proposition to issue $39,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system in Syracuse was carried.

COVINGTON, KY.—The Covington & Big Bone Railroad Company has filed amendments to its charter changing its name to Covington, Big Bone & Carrollton Railroad Company, and increasing its capital stock from $100,000 to $250,000. M. J. Crouch is general manager.

ALEXANDRIA, LA.—The Alexandria Electric Railways Company has been granted a franchise to extend its electric railway system over certain streets in the city in order to reach the Union Depot in Alexandria.

ANNAPOLIS, MD.—Application has been made to the General Assembly by the Montgomery Power Company for authority to consolidate with the Potomac Power Company, a Virginia corporation, and asks to be invested with all the powers enjoyed by that company. It is proposed to utilize the Chesapeake and Ohio Canal, without interfering with transportation, by the construction of a large dam and additional locks. It is estimated that 40,000 hp can be developed, which will be obtained from the Great Falls of the Potomac, and which will be distributed throughout the western part of Maryland for use by the various electric railways extending into Pennsylvania. It is said that leading financiers of Philadelphia and Washington are interested in the project.

BALTIMORE, MD.—A bill has been presented to the State Legislature asking for an amendment to the charter of the Baltimore Light, Heat & Refrigerating Company, giving it permission to change its name and issue $500,000 additional in capital stock.

BALTIMORE, MD.—The stockholders of the Baltimore County Water & Electric Company have authorized an increase in capital stock from $300,000 to $600,000, the proceeds to be used for improvements contemplated in the near future and to provide larger working capital.

BALTIMORE, MD.—It is reported that the Pennsylvania Water & Power Company, which took over the property of the McCall Ferry Company, will extend its transmission lines to Baltimore and furnish at least 100,000 hp in this city. The company is securing the right of way for its transmission line from the Susquehanna River to Highlandtown, where the transforming station will be erected if the lines are extended to Baltimore. The company is waiting for the outcome of the battle against the Consolidated Gas, Electric Light & Power Company, which will distribute electricity furnished by the power company in Baltimore.

ELLICOTT CITY, MD.—The Patapsco Electric & Manufacturing Company has applied to the State Legislature for amendments to its charter, granting it the privilege of entering Baltimore. V. G. Bloede, of Baltimore, Md., is president and treasurer of the company.

ELKTON, MD.—A bill has been introduced in the State Legislature for the incorporation of the Elkton, Fair Hill & Oxford Electric Railway & Power Company, which proposes to construct and operate an electric railway from Elkton through the towns of Cherry Hill and Fair Hill to the Pennsylvania line. The company will be capitalized at $60,000, with the privilege of increasing it to $500,000. The incorporators are: C. P. Carrieo, George E. L. Hess, John Lungren, H. Eugene Mackin and S. Hess.

HAGERSTOWN, MD.—Surveys have been made by the Hagerstown Electric Railway Company for an extension of its electric railway system into the northern suburbs of Hagerstown. W. C. Hepperle is secretary and purchasing agent.

SEVERN PARK, MD.—It is reported that plans are being prepared by the Severn Realty Company for the construction of an electric light plant and water works system on its property at Severn Park, on the

Severn River. Oscar L. Halton, 111 North Charles Street, Baltimore, Md., is secretary and treasurer.

EASTHAMPTON, MASS.—Work will soon commence by the Amherst & Easthampton Power Company on construction of its high-tension transmission line from Amherst to Easthampton. The company will furnish electricity to the West Boylston mill and other industries in Easthampton. The proposed line will be 12 miles long and will cost about $75,000. The contract for construction of the line has been awarded to Fred T. Ley & Company, of Springfield, Mass.

EAST WAREHAM, MASS.—The new mill of the New Bedford Agawam Finishing Company is nearly completed and will soon be placed in operation. The mill is equipped for electric motor drive. E. S. Graves is treasurer.

FRAMINGHAM, MASS.—The citizens are considering the question of purchasing the property and rights of the Edison Electric Illuminating Company of Boston, in Framingham and establishing a municipal electric plant. The Board of Trade has voted in favor of appointing a committee to investigate the subject and make a report and recommendation to the town at some future time.

GREAT BARRINGTON, MASS.—The State Board of Gas and Electric Light Commissioners has granted the Great Barrington Electric Light Company permission to issue $80,000 in additional capital stock, the proceeds to be used for payment of floating debt.

PITTSFIELD, MASS.—The Pittsfield Electric Company is reported to have placed an order with the General Electric Company, of Schenectady, N. Y., for a 1000-hp turbo-generator set, which will be placed in the new addition to be erected at the Spring Lake plant. The cost of the machine is estimated at $15,000.

SPRINGFIELD, MASS.—Bids will be received by the Board of Fire Commission until April 2 for the construction, including heating, plumbing and electric work of headquarters building for the Fire Department of the City of Springfield, Mass.

SPRINGFIELD, MASS.—Sealed proposals will be received by the Commissioners of Hampden County, Court House, Springfield, Mass., until April 6 for lighting fixtures for the Hampden County Court House, at Springfield, Mass. Drawings and specifications may be seen at the office of Kirkham & Parlett, architectc, Court House Place, Springfield. Bidders may also submit other drawings and specifications with prices therefore. C. C. Spellman is chairman of Commission.

WAREHAM, MASS.—The Town of Wareham has entered into a contract with the Marion Gas Company, of Marion, Mass., for the installation of an electric lighting system in this town. It is expected to have the service in operation not later than June 1, 1910. Under the terms of the contract the company is to furnish electricity for street lamps as follows: For 25-cp tungsten lamps, $1.20 each per month; 32-cp lamps, $1.25 each; 40-cp lamps, $1.50 each, and 60-cp lamps, $1.75 each. The prices for electrical energy for lamps for domestic lighting are as follows: First 200 kw per year, 15 cents per kw-hour; the third 100 kw, 12 cents per kw-hour, and the fourth 100 kw, 10 cents per kw-hour. The following rates will be charged for energy for motors: Up to one-half hp maximum demand, 15 cents per kw-hour; one-half to 5 hp, 10 cents per kw-hour; from 5 to 10 hp, 8 cents per kw-hour, and over 10 hp, 6 cents per kw-hour.

DETROIT, MICH.—Plans have been completed for the construction of a large forge plant for the Anderson Forge & Machine Company, of Detroit, Mich. The plans call for the erection of nine buildings, including a power plant, 60x50 ft. The total cost of the plant is estimated at $750,000. Construction work will begin as soon as contracts are let.

KALAMAZOO, MICH.—The King Paper Company is erecting a new paper manufacturing plant, which will be equipped throughout for electric motor drive, electricity for which will be generated in a power house in connection with the plant. The electrical equipment will be furnished by the Allis-Chalmers Company, of Milwaukee, Wis., and will include one 1000-kw, 240-volt, 95 r.p.m. engine type generator, a 200-kw, 240-volt, 425 r.p.m. direct-current generator and 95 direct-current motors ranging from 125 hp down.

LANSING, MICH.—The Lansing & Northeastern Electric Railway Company has received authority from the Michigan Railway Commission to issue $800,000 in bonds, the proceeeds to be used for the construction of an electric railway from Lansing to Owosso, a distance of 30 miles. An extension is contemplated from Morrice east through Durand, thence to Flint; also another extension from Owosso to Saginaw. This railway will be operated in conjunction with the Michigan United Railways. The Owosso & Corunna Electric Company's system will be acquired and rebuilt. The third-rail system will be installed. Most of the material has been purchased. Two substations will be erected, one at Morrice and the other at Haslett. Electricity for operating the system will be secured from the Commonwealth Power Company. The company is capitalized at $300,000. T. W. Atwood, of Morris, is president.

ONAWAY, MICH.—The Onaway Telephone Company has increased its capital stock from $50,000 to $100,000.

PORTLAND, MICH.—The Portland-Westphalia Transit Company has taken preliminary steps for the construction of its proposed electric railway from Portland to Westphalia and Forest Hill. Local capital is interested in the project.

ALBERT LEA, MINN.—We are informed that the Consumers Power Company, of Stillwater, Minn., has not acquired the property of the Albert Lea Light & Power Company, as reported in the issue of March 17. Ludwig Kemper is secretary of the company.

MORGAN, MINN.—The Town Council is reported to have contracted with the Wherland Electric Company, of Redwood Falls, Minn., to furnish electricity for lamps in Morgan.

WINONA, MINN.—The Winona Railway, Light & Power Company has recently installed a 600-hp boiler in its Winona power plant.

PHILADELPHIA, MISS.—The Independent Telephone Company is planning to rebuild its telephone exchange in this city, which was recently destroyed by fire, causing a loss of about $5,000.

SUNFLOWER, MISS.—The mill and timber lands, located near Sunflower, have been purchased by Pierce, Coquin & Company, of Fulton, Ky. It is said that the new owners will enlarge the mill, install an electric light plant and drive an artesian well.

COLUMBIA, MO.—In a report submitted to Prof. H. B. Shaw, dean of the engineering school of the University of Missouri, and H. H. Humphrey, of St. Louis, Mo., who were engaged by the City Council to make investigations in connection with enlarging the municipal electric plant and water works system, have recommended making extensions to the plants, at a cost of $125,000.

HANNIBAL, MO.—The E. L. Long Manufacturing Company, it is said, is contemplating establishing an automobile shop, which will be equipped for electric motor drive.

HUNTSVILLE, MO.—At an election held March 15 the citizens voted to issue $38,000 in bonds, the proceeds to be used to purchase the property of the Huntsville Electric Light & Power Company and install a water works system.

TRENTON, MO.—At an election to be held April 5, the proposition to issue $55,000 in bonds for the construction of an electric light and power plant will be submitted to a vote.

WHITEHALL, MONT.—The Montana Independent Telephone Company is planning to commence work on the erection of an extension of its system to Twin Bridges in the near future.

FAIRBURY, NEB.—Plans are being prepared for the construction of a municipal electric light plant and water works system in Fairbury. An election to vote on the proposition to issue $135,000 in bonds has been called. C. H. Denney is chairman of committee.

STERLING, NEB.—The Drummond Electrical Company, of Lincoln, Neb., is reported to have petitioned the Village Board for a franchise to construct and operate an electric light plant in Sterling.

UNIVERSITY PLACE, NEB.—We are informed that the City of University Place will install an electrically driven deep well pump in connection with a 10-in. well, 160 ft. deep. Frank H. Harbigan is commissioner.

CARSON CITY, NEV.—It is reported that extensive water rights in Lundy Lake, Mono County, have been transferred to Messrs. Cain & Metson. It is said that a power plant will be constructed as soon as possible and electricity transmited to Bodie, Aurora, Masonic and Lucky Boy.

MINDEN, NEV.—W. H. Metson and P. O. Chappelle, who control a water power site at Minden, Nev., have awarded a contract to the Allis-Chalmers Company, of Milwaukee, Wis., for the installation of the machinery, which will consist of a 1500-kw, 2200-volt, three-phase, 60-cycle, 400 r.p.m. water wheel type alternator; a 65-kw motor generator exciter set; a 65-kw, direct-connected exciter unit and six 200-kw, 55,000-2200-volt, oil-filled self-cooled transformers.

BLOOMFIELD, N. J.—The Town Council has voted to require the New York and New Jersey Telephone Company to place all its wires underground in Bloomfield.

PATERSON, N. J.—The Board of Managers of the General Hospital is contemplating the installation of a heating and lighting plant at that institution, at a cost of $15,000.

SOUTH RIVER, N. J.—Plans are being considered by the American Silicate Company, of South River, N. J., for the installation of a sand lime plant, which will be equipped with steam pressure cylinders, mixers, dryers, etc. It is understood that the plant will be operated by electricity.

SANTA FE, N. M.—Application has been filed by J. J. Laubach, W. G. Benjamin, W. B. Bunker and William Harper for the Rio Casa power plant. The plant will be located about 40 miles from Las Vegas and will develop about 250 hp.

SANTA FE, N. M.—R. H. Boulware and H. B. Johnson have filed application in the office of the territorial engineer for a water power project to cost $1,200,000. The petition asks for 100 second ft. of water of the Gila River in western part of Grant County.

ALBION, N. Y.—Arrangements are being made by the A. L. Swett Electric Light & Power Company, of Albion, N. Y., for the construction of a new 1000-hp plant, with switching apparatus for operating service lines to Brockport, Waterport and Carlton, and in the Town of Albion.

BINGHAMTON, N. Y.—The City Council is contemplating the question of establishing a municipal electric light plant.

BUFFALO, N. Y.—Plans have been prepared for the construction of a new factory for the Aldrich Manufacturing Company, which will be equipped for electric motor drive.

BUFFALO, N. Y.—Plans are being prepared for the installation of a 750-hp power plant in the Erie County prison, the equipment to include boilers, engine, generators, pumps, etc., including controlling apparatus. The plant will also furnish steam for heating purposes. Bids have not yet been called for.

CLIFTON SPRINGS, N. Y.—The proposition to issue not more than $4,000 in bonds, the proceeds to be used to enlarge the municipal electric light plant, was carried at an election held March 15.

FORT TERRY, N. Y.—Sealed proposals will be received by Captain F. T. Arnold, Constructing Quartermaster, New London, Conn., until April 30, for the construction of an electric light and power plant and electric lighting system; also for minor alterations and furnishing and installing a new boiler in pumping plant at Fort Terry, N. Y. Separate proposals are required for each job. A deposit of $5 will be required for each set of plans. Further information will be furnished on application to Captain F. T. Arnold, constructing quartermaster.

GLENS FALLS, N. Y.—The Mills Power Company, recently formed, it is reported, will be in the market in the near future for an electric generator, driven by a turbine.

OTISVILLE, N. Y.—Bids will be received by the Board of Health, Department of Health, corner of Fifty-ninth Street and Sixth Avenue, New York, N. Y., until April 12, for furnishing material and installing an electric light and power plant, including engine, generator, transformer, electric wiring, etc., on the grounds of the Tuberculosis Sanatorium, at Otisville, N. Y. Blank forms and plans and other information may be obtained at the office of the chief clerk of the Department of Health. Ernst J. Lederle, Ph. D., is president.

POUGHKEEPSIE, N. Y.—The contract for construction of power house, equipment, conduits and piping at the Hudson River State Hospital, at Poughkeepsie, N. Y., has been awarded to the Gaylord & Eitapenc Company, of Binghamton, N. Y., for $96,800.

SYRACUSE, N. Y.—Plans are being prepared by the Cross-Hinds Company, of Syracuse, N. Y., for its new factory buildings, which, it is said, will be equipped for electric motor drive throughout.

SYRACUSE, N. Y.—The Municipal Heating Company is contemplating making application to the City Council for a franchise to furnish light and power, in addition to steam, in this city. Thomas M. Brooks, of Scranton, Pa., is president of the company.

ANSONVILLE, N. C.—A. H. Richardson is reported to be interested in a project to construct a hydroelectric power plant. About 6000 hp will be developed.

FAYETTEVILLE, N. C.—The plant and holdings of the Fayetteville Gas & Electric Company is reported to have been purchased by William W. Randolph, consulting engineer of the Tidewater Power Company, of Wilmington, N. C.

VALLEY CITY, N. D.—The Valley City Street Interurban Railway Company has beeen granted a franchise by the City Council to construct and operate an electric railway over certain streets in this city.

ASHTABULA, OHIO.—Bids will be received by the Ashtabula Electric Railway Company, Ashtabula, Ohio, until April 8 for the construction of 10 miles of electric railway. Plans, specifications and other information can be obtained at the office of the Ashtabula Street Railway Company, Haskell Building, Ashtabula, Ohio.

NORTH BALTIMORE, OHIO.—The Town Council has granted F. J. Miller, of Fostoria, Ohio, a franchise to construct and operate an electric light plant in North Baltimore. Under the terms of the franchise the plant must be completed within 90 days.

NORTH BALTIMORE, OHIO.—E. J. Miller, who has been granted a franchise by the Town Council for the construction of an electric light plant and contract for street lighting, failed to deposit his bond at the time agreed upon, and has not communicated with the Village Council. It is said that there is some talk of a municipal electric plant.

PIQUA, OHIO.—The Piqua Home Telephone Company has filed an amendment to its charter increasing its capital stock from $100,000 to $160,000.

SANDUSKY, OHIO.—The City Council is considering the question of establishing a municipal electric light plant in connection with the water pumping station, the cost of which is estimated at about $40,000.

SANDUSKY, OHIO.—The Lake Shore Railway Company has offered the County Commissioner $12,000 for a 25-year franchise to construct an electric railway over the new bridge to be erected across the Huron River, at Huron. F. W. Coen is general manager.

TIFFIN, OHIO.—The Sterling Emery Wheel Company is reported to be contemplating discarding its steam plant and equipping its plant for electric motor drive. Bids will be received by the company for equipment for same, including 15 or 20 alternating-current motors.

TOLEDO, OHIO.—It is reported that the newcomers of the Vulcan Shovel Company, of Toledo, Ohio, are preparing plans for the construction of an entire new plant, which will be equipped with direct-connected alternators, water tube boilers, cranes, cupolas, etc. Carl Horix is general manager.

MEDFORD, OKLA.—The citizens on March 8 voted to issue $18,000 in bonds, the proceeds to be used for the construction of an electric light plant and $12,000 for extensions to water works system. O'Bannon & Foster, of Blackwell, Okla., are engineers. C. W. Stephenson is clerk.

OKLAHOMA CITY, OKLA.—The Pioneer Telephone Company is contemplating the installation of three additional exchanges, one at Capitol Hill, Twenty-eighth Street, and on the fourth floor of the present exchange, increasing the capacity to 45,000 telephones.

PITTSBURG, OKLA.—The Pittsburg Water & Light Company, recently incorporated, will commence work at once on the construction of an electric light plant and water works system for Pittsburg.

SHAWNEE, OKLA.—The Big Four Packing Company, recently incorporated, is planning the construction of a four-story building, 209 x 354 ft., at a cost of $300,000. The plant, it is said, will be equipped with motor-driven meat packing machinery.

WALTER, OKLA.—The contract for construction of electric light plant, water works and sewer systems, has been awarded by the city to E. R. Kerby, of Lawton, Okla. The O'Neil Engineering Company, of Dallas, Tex., has charge of the work.

DALLAS, ORE.—A franchise has been granted to E. W. Thomas, representing Philadelphia capitalists, to construct and operate an electric railway in Dallas. It is expected that the proposed railway will be extended to Dry Hollow and Three-Mile Creek.

FOREST GROVE, ORE.—Application has been made to the City Council by E. W. Haines, president and manager of the Haines Electric Power Company, for a franchise to erect transmission lines out of the city. It is understood that the company is contemplating extensive improvements, including the installation of a steam power plant to be used as auxiliary to its hydroelectric plant and also establishing a 24-hour service. It is probable that the company will also furnish electrical service in Cornelius, Banks, Gaston and other towns.

MEDFORD, ORE.—The American Development Company has applied to the county court for a franchise to construct and operate an electric railway over certain roads in Jackson County.

ALTOONA, PA.—The Penn Light & Power Company, which recently took over the two local power plants, has secured control of the Tyrone electric plant, Huntingdon Gas Company, Lewstown Electric Railway & Gas Company and the Juniata Water & Power Company, at Warrior's Ridge, which include all the illuminating and power plants between this city and Lewistown. The headquarters of the consolidated company will be located in Altoona, Pa. E. T. Penrose will be general manager, and E. B. Green general superintendent, both of Altoona, Pa.

ERIE, PA.—It is reported that the Erie Traction Company has decided to increase the output of its power plant. The installation of a low pressure steam turbine operating on exhaust steam from the present plan, is under consideration.

ERIE, PA.—The Erie Engine Works, of Erie, Pa., is contemplating the construction of a new foundry building, 130 x 400 ft., the equipment of which will include several large cranes, two large cupolas, power plant and other appliances for production of gray iron castings.

GETTYSBURG, PA.—We are informed that the Gettysburg Lighting Company is in the market for two 200-hp boilers (Hartford Boiler Insurance Company's specifications), piping, etc. For further information address C. T. Leland, treasurer, 2215-2217 Land Title Building, Philadelphia, Pa.

QUEEN JUNCTION, PA.—The S. H. Roberts Boiler & Tank Company is erecting a new plant in Queen Junction, Pa., which will be equipped for manufacturing car tanks and riveted steel pipe. It is reported that the company will require an air compressor, two-stage type, for 250 cu. ft. of air, a 250-hp, water tube boiler and a 30-kw, 220-volt, alternating-current generator. The company, it is said, will consider second hand equipment.

SHERIDAN, PA.—It is reported that an electric plant will be established at Sheridan. The proposed plant, it is said, will furnish electrical service in Newmanstown, Milbach, Kleinfeltersville and Schaefferstown. Messrs. Martin and Cherington are interested in the project.

WOONSOCKET, R. I.—The Woonsocket Electric Machine & Power Company has decided to install an experimental system of magnetite lamps for street lighting purposes. The company recently installed new lamps, which were not satisfactory.

COLUMBUS, S. C.—Plans are being prepared by the Glencoe Cotton Mills, recently incorporated, for the construction of a 5000-spindle plant, to cost about $115,000. The plant will be equipped for electric motor drive and will require about 225 hp.

DENMARK, S. C.—The Denmark Ice & Fuel Company, which was recently granted a franchise in Denmark, it is reported, will install a plant in November. The company will furnish electricity for street lighting, residence and commercial lighting. W. J. Long is president and William D. Garvin is manager of the company.

GREENVILLE, S. C.—The contract for the electrical work on the Masonic Temple at Greenville was awarded to Witman & Mountford, of Macon, Ga.

SIOUX FALLS, S. D.—The Sioux Falls Light & Power Company is reported to have decided to construct an auxiliary steam plant with the same output as its hydroelectric power plant, at a cost of about $116,000. George T. Blackman is president.

FRANKLIN, TENN.—The Franklin Ice Company, recently organized by Parks Lillie, will operate its plant in connection with the local electric light plant, which will necessitate a day service.

LAFAYETTE, TENN.—The citizens are considering the question of issuing $40,000 in bonds, the proceeds to be used for the construction of an electric light plant and water works system.

AUSTIN, TEX.—The City Council has awarded the Dumont-Holmes Concrete & Steel Company the contract for rebuilding the Austin Dam, across the Colorado River, to cost $1,000,000, subject to the vote of the people, for which a special election will be held April 5. The proposed dam will furnish power for operating the municipal electric light plant and water works system.

AUSTIN, TEX.—The Dumont-Holmes Steel Concrete Company has obtained a permit from the State of Texas to carry on business in this State. The company has secured the contract to rebuild the dam across the Colorado River. It also binds itself to operate the dam, hydroelectric plant and water works system during the period of 20 years, that the city is given in which to pay for the work. Joseph C. Dumont is engineer. The principal office of the company is in Chicago, Ill.

BELTON, TEX.—Contracts have been placed by W. W. Thornton and associates for machinery for its proposed electric light and power plant to be erected in Thornton. It is expected to have the plant ready for operation in about two months.

BROWNWOOD, TEX.—The Brownwood North & South Railway Company has awarded a contract to the Texas Building Company, of Fort Worth, Tex., for the construction of its proposed electric railway from Brownwood to May, a distance of 20 miles. John Mead, of Brownwood, Tex., is chief engineer.

CLINT, TEX.—The Clint Telephone Company is planning to erect telephone lines to connect farms, ranches and towns of the lower valley with El Paso, Tex.

CROWELL, TEX.—C. L. Rucker, of Sweetwater, Tex., is reported to have been granted a franchise to construct and operate an electric light plant in Crowell, construction of which has already commenced.

EL PASO, TEX.—The property of the Southwestern Telephone & Telegraph Company, including lines in El Paso, New Mexico and Arizona, has been purchased by the Tri-State Telegraph & Telephone Company, a Colorado corporation, capitalized at $1,000,000. The new company proposes to erect lines to Denver, Douglas, Los Angeles, Bisbee and Globe, at a cost of about $300,000. R. F. Morris, of Colorado Springs, Col., is to be general manager of the company.

GREENVILLE, TEX.—The Delta Electric Light, Power & Manufacturing Company has recently purchased a 150-kw General Electric generator, belted, which will be installed at once.

GREENVILLE, TEX.—Application has been made by S. A. Price, H. J. Myers and associates for a franchise to construct an electric railway in Greenville, Tex. The proposed railway will be five miles in length.

HONDO, TEX.—A. G. Hondo, of Hondo, is reported to be in the market for a small gas producer and gas engine, automatic steam engine and electric generator for the local lighting plant.

HONEY GROVE, TEX.—J. Dannenbauer, of Honey Grove, Tex., is reported to be in the market for a 100-kw electric generating unit, gasoline engine preferred.

MADISONVILLE, TEX.—Plans are being prepared for the construction of an electric light plant in Madisonville. It is understood that the project will be financed by local capital.

SALADO, TEX.—Maclin Robertson, of Salado, is at the head of a movement to construct an electric railway between Salado and Temple, a distance of 14 miles. It is stated that if an extension of the Belton-Temple line to Salado cannot be obtained an independent railway between the two towns will be built.

TEMPLE, TEX.—The interurban electric railway of the Belton-Temple Traction Company, extending between Temple and Belton, will be sold under the decree of the Federal Court by W. G. Haag, receiver, May 3. The foreclosure proceeding is a friendly action on the part of the bond holders, who will buy the property. The bonds are held by a syndicate of Pennsylvania capitalists who will, it is said, not only improve the present railway, but will build an extension to Waco, and probably also to Austin.

TEXAS CITY, TEX.—The Texas City Company is reported to be contemplating doubling the output of its present plant, which now generates 500 hp., for the purpose of supplying electricity for local industries and in nearby towns. The company is erecting several large warehouses upon the docks in Texas City and is equipping them with large overhead electric cranes for handling freight. Electric cranes will also be installed upon the docks for loading and unloading vessels. Electric motors, using the third-rail system, will handle the cars in the yards and upon the docks.

VICTORIA, TEX.—A syndicate of local men, consisting of J. H. Hexter, F. B. Lander, J. N. Fagan, T. A. Setterle and A. A. Setterle, has applied to the City Council for a franchise to construct and operate a street car system over the principal streets of the city, to be operated by electricity or gasoline motors.

WACO, TEX.—The Brazos Valley Cotton Oil Company is planning to install an engine driven unit, with a rating of from 400 to 500 hp, with exciter, switchboard and other equipment.

BOUNTIFUL, UTAH.—The different commercial interests in Bountiful have sent a formal request to the Utah Light & Railway Company, of Salt Lake City, Utah, asking the company to extend its street car system from its present terminus in North Salt Lake to Bountiful, a distance of about six miles. In making the request the right of way in this city is guaranteed and local interests have agreed to undertake to secure from the County Commissioners a franchise outside of the town.

BRIGHAM CITY, UTAH.—A large transformer and other equipment, it is said, will be installed in the electric power plant of the Ogden Portland Cement Company, of Brigham City.

LEVAN, UTAH.—The question of establishing a municipal electric light plant and new water system in Levan is under consideration.

MONROE, UTAH.—The Town of Monroe has filed an application with the state engineer for water rights in Monroe Creek, to be developed to generate electricity to be utilized in Monroe for lamps and motors. The water will be brought through a pipe line 8000 ft. long from a masonry dam to the power plant, where 850 hp would be developed.

NEPHI, UTAH.—The City Council is reported to be considering the question of installing an entirely new electric light plant to replace the present system. Plans are being prepared to light the city park and install two or three sanitary fountains on Main Street.

PROVO, UTAH.—The City Council has adopted a resolution calling for an election to vote on the proposition to issue $188,000 in bonds, the proceeds to be used for the construction of an electric light plant and for moving the water mains from the river bottom to the high ground on the east beach.

RICHFIELD, UTAH.—A notice of appropriation of water rights, in what is known as Daniel's Canyon, near Plateau, has been filed by J. H. Manson, Hugh E. Lisonbee and Milan Packard. It is estimated that from 600 to 1000 hp can be developed at this point. It is understood that work on the project will commence at once.

SALT LAKE CITY, UTAH.—The contract for the construction of the large electric plant to supply electricity and heat for the various buildings owned by the Mormon Church in the north end of the business section of the city, is reported to have been awarded to the Trent Engineering & Machinery Company, of Salt Lake City. In addition to the construction of the power house and heating plant, the work will include the tunneling of a number of streets to carry the pipes and wires to the various buildings. The cost of the work is estimated from $150,000 to $200,000. Gray & Grosh are consulting engineers.

CAPE CHARLES, VA.—The New York, Philadelphia & Norfolk Railroad Company is reported to have awarded contracts for the construction of buildings for shops, power house, roundhouses, etc., to cost about $125,000.

GRAHAM, VA.—The Council is considering the question of granting a franchise for electric lighting at the expiration of the present franchise, June 1.

MALVERN HILL, VA.—Preparations are being made by the Henrico-Charles City Telephone Company, recently organized with a capital stock of $5,000, to erect a telephone line to connect with the Charles City telephone line at Malvern Hill post office, with branches to Varina and Fort Lee, Va.

ROANOKE, VA.—The Roanoke Railway & Electric Company is planning to double-track one mile of its railway system on Jefferson Street, Roanoke, and building an extension to Crystal Spring, a distance of one mile.

VINTON, VA.—The Roanoke Railway & Electric Company has petitioned the Council for a franchise to extend its system to Vinton, to furnish electricity for lamps and motors in this town. J. W. Hancock, of Roanoke, Va., is manager.

CENTRALIA, WASH.—The Board of County Commissioners has granted the Tenino Light & Power Company a franchise to erect a transmission line from the Thurston County line to Chehalis. The company is erecting a hydroelectric power plant at the head waters of the Shookumchuck River, on which it has already spent $40,000 in developing the same.

CENTRALIA, WASH.—The Twin City Light & Power Company has awarded the contract for the construction and equipment of its proposed electric railway from Centralia to Chehalis, five miles in length, and also for the reconstruction of its electric lighting and water plants to A. M. Hewes, Monadnock Building, Chicago, Ill. The company has recently been re-organized by Guy M. Walker, of New York, N. Y.

NORTH YAKIMA, WASH.—Steps have been taken by the west side business men to install a new cluster lamp lighting system in that part of the city.

NORTH YAKIMA, WASH.—Preparations are being made by the Pacific Telephone and Telegraph Company for extensive improvements to its system in North Yakima, which will involve an expenditure of about $50,000.

BUCKHANNON, W. VA.—The Buckhannon & Clarksburg Electric Railway Company has applied for a charter to construct an electric railway between Buckhannon and Clarksburg. The company will be capitalized at $100,000. The incorporators are: U. G. Young, E. W. Martin, W. H. Fisher, G. C. Young and R. I. Perfine.

CHARLESTON, W. VA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until May 4 for the construction, including plumbing, gas piping, heating apparatus, electric conduits and wiring and standard clock system, of an extension and remodeling, etc., to the United States post office and court house, at Charleston, W. Va. James Knox Taylor is supervising architect.

MIDDLEBOURNE, W. VA.—The Middle Island Railroad Company, which proposes to construct an electric railway from Sistersville to Middlebourne, McElroy Creek and Clarksburg, will apply for a charter in West Virginia. The incorporators are: T. Moore Jackson, C. P. Stout of Clarksburg, W. Va.; I. M. Underwood, T. P. Hill and J. E. Shore, of Middlebourne, W. Va.

WELLSBURG, W. VA.—The capital stock of the Wellsburg Home Telephone Company has been increased from $50,000 to $75,000.

BENTON, WIS.—The Peaceful Valley Lead & Zinc Company is contemplating the installation of a new concentrating and power plant.

MILWAUKEE, WIS.—The Ellington Farmers' Telephone Company has filed an amendment to its charter increasing its capital stock from $2,000 to $8,000.

OSHKOSH, WIS.—Preparations are being made by the Waite Grass Carpet Company for the construction of a large factory in Oshkosh, Wis., which will probably be equipped with power apparatus, sprinkler system, blowers, boilers, etc.

WAUKESHA, WIS.—The Waukesha Lime & Cement Company is contemplating the installation of alternating-current motors to drive the machinery in its plant.

WAUSAU, WIS.—The new mill of the Wausau Sulphate Fiber Company, which will be erected on the Wisconsin River, near Wausau, will be operated by steam power, for which engines and boilers will soon be purchased. The power plant equipment will ultimately be replaced by hydraulic turbines and generators. The plant, it is said, will be equipped for electric motor drive from the start.

BRANTFORD, ONT., CAN.—Although this city voted a year ago against the hydroelectric power proposition, announcement has been made that a substation would be erected half way between Brantford and Paris in order to supply electricity in either municipality should a contract be made.

LONDON, ONT., CAN.—Contracts have been awarded by the Water Commissioners for electrical equipment amounting to $50,556, of which the Canadian General Electric Company secured $25,745 and the Canadian Westinghouse Company $24,811.

NIAGARA FALLS, ONT., CAN.—It is reported that the Ontario Power Company is contemplating the construction of a duplicate 18-ft. steel penstock, together with rock excavations for the third and final penstock. General F. V. Greene, of Buffalo, N. Y., is vice-president of the company.

WELLAND, ONT., CAN.—C. J. McLaughlin, of Hartford, Conn., has petitioned the Town Council for a 20-year franchise to construct and operate an electric railway in Welland.

MONTREAL, QUE., CAN.—Bids will be received until April 9 by E. A. Robert, managing director of the Canadian Light & Power Company, Montreal, Que., for rock and earth excavation in the Beauharnois Canal between Valleyfield and Timothee; also for intake works at Valleyfield, including cofferdam and culverts.

SHERBROOKE, QUE., CAN.—The Sherbrooke Street Railway Company has been granted a new franchise for a term of 28 years. It is understood that extensive improvements and extensions will be made to the system, including the rebuilding of the present system and extensions to surrounding towns and villages and developing a water power on the Magog River, which will involve an expenditure of about $500,000. It is understood that the control of the company has passed to interests represented by Col. F. W. Hibbard, of Montreal, Que.

MOOSE JAW, SASK., CAN.—The City Council is considering a proposition submitted by an Ottawa firm for granting a franchise for the construction of an electric railway system in Moose Jaw. The proposed franchise calls for the construction of three miles this year and the same number next year.

REGINA, SASK., CAN.—The City Council has decided to grant a street railway franchise to J. W. de C. O'Grady, J. Ceddes and J. A. Anderson, all of Winnipeg, Man., subject to ratification by the ratepayers. Under the terms of the franchise the company is to have seven miles of track built before Dec. 1, 1910, and placed in operation by May 1, 1911. When the gross earnings of the company reach $8,000 per mile of track the company is to pay the city 5 per cent of its gross earnings; $9,000, 7½ per cent; $10,000, 10 per cent; $12,000, 12½ per cent; $15,000, 15 per cent. The city is to have the privilege of taking over the system at the expiration of the franchise.

ORTIZ, CHIHUAHUA, MEX.—Antonio Ramos Cadena and Serveriano Calderon have been granted a concession by the State Government for the construction of an electric railway to extend from Ortiz to Meoqui, a distance of about three miles. A local system will also be established in both towns. The proposed railway will furnish both freight and passenger service.

PACHUCA, MEX.—The Mexican Light & Power Company is erecting an electric transmission line to the Pachua mining district and expects to be able to furnish electrical service to the mining companies with which it has contracts by the middle of July. The company has recently taken over the properties of the Hydro-Electric & Irrigation Company, of Hidalgo.

New Industrial Companies.

THE W. L. BROWNE ELECTRICAL COMPANY, of Worcester, Mass., has been incorporated with a capital stock of $8,000 to carry on the business of W. L. Browne, electrician, at 545 Main Street, Worcester. W. L. Browne is president and treasurer of the company and John R. Fitton, clerk.

THE ELECTRICAL DISPLAY COMPANY, of Chicago, Ill., has been chartered with a capital stock of $10,000 to manufacture electrical devices and appliances. The incorporators are: Samuel I. Levy, J. A. Bergmann and P. O. Myberg.

THE ELECTRIC MACHINE EQUIPMENT COMPANY, Oklahoma City, Okla., has been formed to carry on general electrical constructing and engineering business and to act as general agents for manufacturers of electrical equipment for isolated and central stations in Oklahoma, as well as agents for electrical specialties. The new firm will be glad to receive catalogues and other trade literature for its office files.

THE WILLIAM M. HOFFMAN ENGINEERING COMPANY has been incorporated with a capital stock of $100,000 by F. B. Allen, 410 Franklin Street, Toronto, Ont., Can.; James Wood, 31 North Sherbourne Street, Toronto, Ont., Can.; William M. Hoffman, 214 Maryland Ave, Buffalo, N. Y., and others. The company proposes to manufacture and sell boilers, engines, dynamos, etc.

THE LORD MANUFACTURING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $100,000 for the purpose of manufacturing and dealing in electrical appliances, etc. The incorporators are: Frederick W. Lord, William R. Garton, Frederick W. Erickson, all of New York, N. Y.

THE SOUTHERN ELECTRICAL SUPPLY COMPANY, of Thomasville, Ga., has been formed by J. C. Beverly and G. Rudisill for the purpose of dealing in electrical supplies.

THE STANDING POLE CREOSOTING COMPANY, of Brookville, Ind., has been chartered, with a capital stock of $5,000, by T. C. Munn, R. H. Cook and G. K. Schofield. The company proposes to conduct a creosoting plant and will also send out crews to creosote poles now standing, guaranteeing the preservation for a certain time.

THE STATES ELECTRIC COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $5,000 by W. A. Bither, Frank T. Murray and J. A. Obermiller. The company proposes to manufacture and deal in electrical and mechanical machinery, etc.

THE TUTTLE MOTOR COMPANY, of Canastota, N. Y., has been incorporated by S. E. Brown, of Syracuse, N. Y.; J. S. Munroe, of Camillus, N. Y., and D. M. Tutle, of Canastota, N. Y. The company is capitalized at $150,000, and proposes to manufacture gas engines, automobiles, motor boats, etc.

THE WESTERN ELECTRIC SUPPLY COMPANY, Ltd., of Fort William, Ont., Can., has been incorporated with a capital stock of $40,000 by H. James, C. D. Milner, C. H. Ley, Sterling Jaffray and R. H. Neeland, all of Fort William, Ont., Can.

New Incorporations.

PITTSBURG, OKLA.—The Pittsburg Water & Light Company has been chartered for the purpose of constructing and operating an electric light plant.

OAKLAND, CAL.—The Sacramento River Power Company has been incorporated with a capital stock of $200,000 for the purpose of erecting a large power plant on the Sacramento River, near Kennet, where it is estimated that about 100,000 hp can be developed. Frank T. Large is president; Perry W. Mark, vice-president, and W. F. Arma, of Oakland, Cal., is secretary.

WOONSOCKET, R. I.—The Manufacturers Power Company has been chartered by Charles L. Harding, of Dedham, Mass.; Nathaniel F. Ayer, of Boston, Mass., and Ervin S. Dunn, of Woonsocket, R. I. The company is capitalized at $100,000, and proposes to furnish both electrical and steam power for the Samoset Worsted Company and the Nyanza mills, which are to be erected on the Rathburn land, near Cold Spring Park, this year.

ASHEVILLE, N. C.—The Dixie Mining & Power Company has been incorporated with a capital stock of $200,000 by A. E. Swayne and associates, of Asheville, N. C.

McMINNVILLE, TENN.—The Faulkner Light & Power Company has been chartered for the purpose of building a dam across Collins River, the water power to be utilized to generate electricity to be transmitted to McMinnville and Faulkner and other towns for lamps and motors. The incorporators are: Clay Faulkner, H. C. Faulkner, M. T. Bass, C. J. Bryan and John L. Willis.

CISCO, TEX.—The Star Electric Company has been incorporated with a capital stock of $25,000 by W. C. Bedford, F. M. Oldham and Henry Benham.

THERMOPOLIS, WYO.—Articles of incorporation have been filed for the East Thermopolis Power Company by H. P. Rothwell, Martin McGrath and Ira E. Jones. The company proposes to construct and operate a street railway system in Thermopolis, and also to erect and operate an electric light and water system in what is to be known as the East Thermopolis addition.

Personal.

MR. MILES V. STEWART, formerly commercial engineer with the General Electric Company of Schenectady, N. Y., has been appointed chief engineer for the Mexican General Electric Company, Mexico City, Mexico.

MR. STANLEY BEETON, director of the Morgan Crucible Company, Battersea Works, London, England, is visiting this country in the interest of his company.

MR. LOUIS J. AUERBACHER has become associated with the Western Electric Company, New York, and will devote his energy to the flaming-arc lamp.

MR. EDGAR STRASBURGER, of the Western Electric Company, has been placed in charge of the company's cable manufacturing plant at North Woolwich, England.

PROF. JOHN R. ALLEN, of the University of Michigan, has accepted an offer made by President Gates, of Roberts College, Constantinople, to establish there a course in engineering.

MR. H. M. BYLLESBY, of Chicago, will buy property and erect a home in San Diego, Cal. Mr. Byllesby is president of the San Diego Gas & Electric Company, of Medford, Ore.

MR. A. E. HURSCH, who formerly served as manager for the San Joaquin Light & Power Company at Selma, Cal., has been placed in charge of the Coalinga (Cal.) Light & Power Company.

MR. L. P. HAMMOND, formerly sales manager for the Denver Engineering Works, Denver, Col., has been appointed sales manager for the Central Colorado Power Company, with headquarters at Denver.

MR. E. M. SCRIBNER, formerly of the General Electric Company in San Francisco, has accepted a position as Western sales manager of the Arrow Electric Company, of Hartford, Conn., with headquarters in Chicago.

MR. FRANKLIN P. WOOD has resigned his position as superintendent of the Black Hills Traction Company, Deadwood, S. D., to become manager of the Southern Colorado Power & Railway Company, Trinidad, Col.

MR. W. J. HOLMAN, formerly with the Huntingdon light and power plant, of Huntingdon, Tenn., has taken charge of the plant of the Princeton Light & Power Company, of Princeton, Ky. Mr. Holman also has interests in Dayton, Tenn.

MR. JAMES H. WISE, civil and hydraulic engineer, has become associated with F. G. Baum & Company, San Francisco, Cal., and will have charge of civil and hydraulic work in connection with water power and irrigation reports and developments.

MR. J. M. NELSON, resident engineer of the Connecticut River Transmission Company, presented a paper on March 24 before the Worcester Polytechnic A. I. E. E. branch entitled "The High-tension System of the Connecticut River Transmission Company."

PROF. J. W. ESTERLINE, of Purdue University, Lafayette, Ind., who was engaged by the city of Crawfordsville, Ind., to report on its municipal lighting plant, has recommended that the entire plant be "scrapped" and a new one erected at a cost of $93,000.

MR. F. X. CLEARY has been appointed advertising manager of the Western Electric Company. Mr. Cleary has been with the Western Electric Company for about 20 years, and has held important positions connected with the execution of sales campaigns for the company.

MR. J. E. DAVIDSON has resigned as president and manager of the Consolidated Lighting Company, of Montpelier, Vt., and will take up managerial work in Oregon and Washington for the American Light & Power Company, one of the holding companies of the Bond & Share Company.

MR. B. J. FALLON, heretofore engineer of maintenance of way of the Metropolitan West Side Elevated Railway Company of Chicago, has been appointed assistant general manager of that company. Mr. James Walker, formerly consulting engineer for the company, has been made chief engineer. These changes went into effect Mar. 1.

MR. W. L. PARKENHAM, general manager of the "Z" Electric Lamp Manufacturing Company, of Engand, and a director of the American "Z" Electric Lamp Company, who has been in America for some time investigating the incandescent lamp situation, with a view to introducing the "Z" lamp here, left for England on the *Mauretania* March 23.

MR. B. F. DILLON, formerly district superintendent of the Western Union Telegraph Company at Jacksonville, Fla., has been made general superintendent of the southern district for the company, with headquarters at Atlanta. Mr. Dillon succeeds Mr. Jacob Levin, who recently resigned after having been in charge of the southern district for several years.

MR. A. B. COWAN, formerly chief operator of the Chicago office of the Western Union Telegraph Company, has been promoted to the position of assistant superintendent of the first district of the western division, with headquarters in Chicago. Mr. Cowan began his service with the company 28 years ago as an operator. He is succeeded as chief operator of the local office by Mr. C. H. Finley.

MR. JAMES DIXON, formerly with the Westinghouse Storage Battery Company at Boonton, N. J., has become a member of the engineering staff of the Crocker-Wheeler Company, at Ampere, N. J. At the time of its consolidation with the storage battery department of the Westinghouse Machine Company, Mr. Dixon was manager of sales and production of the General Storage Battery Company.

MR. GEORGE H. GROCE, who for the last six years as assistant to the general manager of the Illinois Central Railroad has had immediate charge of matters relating to signals, telegraphs and other electrical equipment for that road, has just resigned his position at Chicago, to become associated with the General Railway Signal Company, of Rochester, N. Y. Mr. Groce will have the title of assistant to the president of the signal company, and is to make his headquarters in New York City.

MR. EDWARD J. HALL, former president of the Southern Bell and now chairman of the executive committee of the Western Union Telegraph Company and vice-president of the American Bell Company, has been touring the South in the private car "Morse," owned by the Western Union Telegraph Company. With Mr. Hall were Mr. Belvidere Brooks, general manager of the Western Union; Mr. Frank A. Pickernell, assistant to the chairman, and Mr. Samuel Williams, special agent. President Gentry, of the Southern Bell, joined the party at Richmond, Va.

MR. CHARLES M. COHN has been appointed vice president and general manager of the Baltimore Consolidated Gas, Electric Light & Power Company. Since 1906 Mr. Cohn has been secretary of the company, and for some time past has been discharging the duties of general manager. Mr. Cohn is a graduate of Loyola College and an alumnus of the Baltimore University School of Law. He began his business career in the gas department of the Consolidated company, was made acting secretary in 1905, and secretary in 1906. He is a member of the American Gas Institute, National Commercial Gas Association and Illuminating Engineering Society.

MR. W. S. HEGER, manager of the Los Angeles office of the Allis-Chalmers Company, has, in addition to those duties, taken the management of the San Francisco office of the company, succeeding Mr. R. B. Elder, resigned. Mr. Heger has been actively associated with the sale of electrical and power apparatus on the Pacific Coast for more than 20 years. In 1889 he opened the San Francisco offices of the Edison Company for isolated lighting, which was finally merged in the General Electric Company. For 10 years following 1895 he was Pacific Coast manager of the Westinghouse Electric & Manufacturing Company, having established its offices in San Francisco. In 1905 he resigned to become assistant to the president of the Allis-Chalmers Company.

MR. FRANCIS A. VAUGHAN and Mr. Hans J. Meyer have formed the firm of Vaughan & Meyer, consulting engineers, with office at 909 Majestic Building, Milwaukee, Wis. Mr. Vaughan has been electrical engineer of the lighting department of the Milwaukee Electric Railway & Light Company, of Milwaukee, Wis., for the last 14 years. He graduated from the electrical engineering course of the University of Wisconsin in 1895, and after brief terms of service with the Standard Telephone Company of Madison, Wis., and the Gibbs Electric Company of Milwaukee, became connected with the central-station company in Milwaukee. Mr. Meyer, the junior member of the firm, began his career as an apprentice with the Milwaukee Electric Railway & Light Company. He was afterward connected with the Chicago offices of the Bullock and Wagner companies, and later was superintendent of the Shreveport (La.) Gas, Electric Light & Power Company, in which position he entirely remodeled the power plant and distribution system of that company. Since 1906 he has been commercial engineer in the New Orleans office of the Westinghouse Electric & Manufacturing Company.

MR. WALTER M. McFARLAND, who has been associated with the Westinghouse Electric & Manufacturing Company since Jan. 1, 1899, has resigned to accept an official position with the Babcock & Wilcox Company. Mr. McFarland has occupied the office of acting vice-president for the Westinghouse Electric & Manufacturing Company for a period extending over ten years. In this capacity he has had official supervision of the large contracts of the company, as well as being the advisory head in all the co-operative movements of the company with the associated Westinghouse Companies, involving literature, advertising and exhibition work. As a frequent representative of the Westinghouse Companies at important meetings of engineering societies and at conventions, he is well known, and he has long been looked upon, by his company at Pittsburg, as the official host. In the latter capacity he has come into contact with many distinguished engineers and other guests from all parts of the world. His broad experience in engineering matters in general, attained through his previous work in the United States Navy, and his personal acquaintance with men of public affairs, entirely fitted him for duties of this character. In his connection with the Westinghouse Electric & Manufacturing Company he has done much to systematize and improve the work of the departments with which he has come into contact and has, through his personal qualities, won the confidence and respect of the large number of employees looking to him for guidance and direction. Mr. McFarland was graduated from the engineering course of the United States Naval Academy in 1879, ranking second in his class. In 1898 he was commissioned as chief engineer, being the youngest officer for more than twenty years to have reached

MR. W. M. M'FARLAND.

this grade. When the "personnel board" was assembled by the Secretary of the Navy in 1897, Mr. McFarland had the honor of acting as the sole sponsor for the younger men of his corps. As a member of the board, he had the special confidence of its presiding officer, Theodore Roosevelt, then Assistant Secretary of the Navy, and he proved a powerful advocate before the Congressional committee of the measures it recommended, drawing from them the comment that he was the best-posted man that they had ever examined. In 1899, after the passage of the "personnel bill,' he was commissioned lieutenant, and the same year resigned to enter the employ of the Westinghouse Electric & Manufacturing Company. Aside from a wide experience in sea service, Mr. McFarland was attached to the Bureau of Steam Engineering in 1882. From 1883 to 1885 he was detailed from the Navy as assistant professor of mechanical engineering at Cornell University, and during the year 1885 and 1886 he was occupied with the inspection of machinery then building, and with work on preliminary design for proposed vessels. From 1889 to 1904 he was again attached to the Bureau of Steam Engineering. He was vice-president of the American Society of Mechanical Engineers in the year 1907, and at the present time is vice-president of the Society of Naval Architects & Marine Engineers. He is also a member of the Engineers' Club of New York, Duquesne Club of Pittsburg, the Army and Navy Club of Washington, and the Army and Navy Club of New York. He has been a frequent contributor to the technical press, and his papers on engineering topics have won for him a high reputation as an engineer of broad experience and advanced ideas. Mr. McFarland will be located at the general offices of the Babcock & Wilcox Company in the Singer Building, New York City.

MR. HARRY G. GLASS has accepted a position in the industrial and power sales department of the Westinghouse Electric & Manufacturing Company, where he will devote himself to the promotion of co-operation between the central station and the manufacturer in building up day-loads.

MR. HARRY G. GLASS.

Mr. Glass' central-station experience began in the capacity of engineer and local troubleman for the Waynesburg Electric Light, Heat & Power Company, Waynesburg, Pa. The following year he accepted a position as chief engineer with the Oakmont Electric Company, but later he was recalled to Waynesburg to become superintendent of the Waynesburg company. The next position he occupied was that of first engineer of the Washington Electric Light, Heat & Power Company, of Washington, Pa. After serving with this company a year, he was made chief electrician of the Page woven-wire fence plant at Monnessen, Pa., where he remained three years. He then became connected with the Monongahela Valley Electric Company, and had charge of the so-called "Ridinger Plants," consisting of the Monongahela Valley Electric Company, the Donora Light, Heat & Power Company, the Monongahela Electric Company and the Elizabeth Electric Light, Heat & Power Company. When these plants were merged and bought out by the West Penn Electric Company, Mr. Glass was retained in charge as district superintendent, having had added to his territory in the meantime the Charleroi and Belle Vernon districts. After having held this position three years, Mr. Glass was transferred to the general office of the company, located at Connellsville, as assistant to the general superintendent, and later was made superintendent of lighting and power, which position he resigned a year ago to take charge of the electrical department of the H. W. Johns-Manville Company, Pittsburgh, Pa.

Obituary.

MR. JOHN HEATHCOTE, treasurer of the Russell Electric Manufacturing Company, of Providence, R. I., died at his home in that city on March 14. Mr. Heathcote was 77 years of age, having been born in 1833 in Manchester, England. He has resided in this country since 1842.

MR. MATTHEW ROBERT WOLFE, veteran telegraph and telephone man, died in Wheeling, W. Va., last week at the age of 67 years. Mr. Wolff was division superintendent of the Bell Telephone Company, his division comprising 21 counties in Ohio and West Virginia. He was born in Steubenville, Ohio, beginning life as a messenger boy, later becoming a telegrapher and afterward interesting himself in the telephone business.

Trade Publications.

ELECTRIC GAS IGNITERS for domestic service are fully described and illustrated in a folder issued by the Osburn Electric Company, Detroit, Mich.

FLEXIBLE NON-METALLIC TUBING for covering wires in electric lighting installation is described in a folder of the National Metal Molding Company, Pittsburgh, Pa.

INCANDESCENT LAMPS.—The Sunbeam Incandescent Lamp Company, Chicago, Ill., has issued a booklet describing methods for determining illumination by means of incandescent lamps and prismatic reflectors. Illustrations and ratings are given for its metallic-filament lamps.

DIRECT-CURRENT MOTORS.—Bulletin No. 1119 of the Fort Wayne Electric Works, Fort Wayne, Ind., is devoted to direct-current motors for industrial service. For variable speed work these motors are equipped with so-called regulating poles for preventing sparking at the commutator.

CENTRAL-STATION AD. BOOK.—Ad-book No. 13, issued by the Westinghouse Electric & Manufacturing Company, consists of "Moving Day" copy, which brings out the desirability of selecting a wired residence, or to adopt the electric motor for power purposes in the new shop.

ELECTRIC FANS.—The Robbins & Myers Company, Springfield, Ohio, has issued an attractive bulletin giving complete information concerning all types of fans for residence, office and hotel service. The motors of these fans are designed for operation at all standard voltages and frequency, and for direct and alternating current.

PUMPS.—Self-contained pumps of the reciprocating type, directly driven through worm gearing, are fully discussed in a booklet issued by the Fort Wayne Engineering & Manufacturing Company, Fort Wayne, Ind. The features claimed for this type of pump are a smooth and noiseless action, economy of operation, durability and compactness.

MINE TELEPHONES.—The Western Electric Company has issued Bulletin No. 1110, describing its new types of telephone and signal apparatus for mines. The mine signal sets treated consist of a 5-bar magneto-generator for signaling, used with either of two types of bells for receiving signals. One type of bell is equipped with 8-in. gongs and one with 6-in. gongs, the former being protected with a wooden canopy.

AUTOMOBILE ELECTRIC LIGHTING.—The Ward-Leonard Electric Company, Bronxville, N. Y., has issued a neat bulletin devoted to its automatic system of automobile electric lighting. The equipment includes a constant-voltage generator, a storage battery and automatic devices. It is intended for supplying energy to head-lamps, tail-lamps, ignition system, signal system, and to lamps for general illumination.

EVERSHED MEGGER.—James G. Biddle, 1114 Chestnut St., Philadelphia, has published a 20-page bulletin (No. 710) entitled, "Evershed Meggers and Bridge-Meggers." The descriptive matter in this pamphlet was written by Prof. A. J. Rowland, Drexel Institute, and is much more interesting than the contents of the average trade catalog. The Evershed instruments are direct-reading for resistance, just as a voltmeter indicates e.m.f.

SILVER-PLATING PREPARATION.—The Electroline Company, 20 Harrison Street, New York, in referring to a description which appeared in the issue of March 10 of a process for silverplating by immersion, and which was mentioned as a new process, calls attention to a preparation of its manufacture called "Electroline" that acts in an identical manner. This preparation, which has for some time been commercially on the market, gives a permanent silver plating to brass, bronze, steel or nickel articles.

ENGINE-DRIVEN GENERATORS.—The Western Electric Company has just issued a bulletin, No. 5111, descriptive of its new design of "Hawthorn," Type LL, multipolar, engine-driven, direct-current generators. A full description of all of the details of design and construction is given and the merits of the component parts are pointed out. In addition to the regular two-wire generators, there are described and discussed Type LL, three-wire generators and balancer sets for use with either of two systems for the maintenance of a three-wire system of distribution with balanced voltage.

CIRCUIT FITTINGS.—The Harvard Electric Company, 525 West Van Buren Street, Chicago, Illinois, has issued a new catalogue, known as No. 20, which is descriptive of a part of the many electrical necessities made by the Harvard Company. In this bulletin, which relates chiefly to Harvard patent galvanized channel steel brackets, sectional switch-boxes, conduit boxes, fuse wires, fuse strip, open fuse links, bevel edge self-welding wire joints, fuse blocks and telephone fuses, test connectors, cable hangers, etc., there is given a detailed description of the various Harvard specialties, dimensions, etc.

BUSINESS NOTES.

THE ANDERSON FORGE & MACHINE COMPANY, Detroit, Mich., is now constructing a new plant in that city, consisting of nine buildings, which will cost $750,000. The plant will be ready for occupancy before Aug. 1, and when completed it will be, it is claimed, the largest drop forging plant in the United States.

"WALPOLE JUNIOR" TAPE.—For the convenience of workmen and to meet the demands of those desiring a smaller quantity of tape in an individual package, the Massachusetts Chemical Company, Walpole, Mass., is packing 20 ft. of its Walpole brand in a small round tin box under the title "Walpole Junior." This tape is identical in quality with that bearing the same brand name and put up in 80-ft. lengths.

H. M. BYLLESBY & COMPANY, of Chicago, have opened a branch office in the Lewis Building, Portland, Ore. Mr. C. E. Groesbeck, vice-president, is in charge of this office, and a force of steam, electrical and hydraulic engineers will be maintained, as well as an operating staff for the public-service properties operated by the company in that section of

the country. The Portland office is established to take care of the expanding interests of H. M. Byllesby & Company in the Northwest, and also to facilitate the consulting practice of the company.

DODGE & DAY, engineers, Philadelphia, have been retained by the Reliance Electric & Engineering Company, Cleveland, Ohio, to prepare preliminary plans and recommendations for a new plant which this company is about to build. The Reliance Electric & Engineering Company manufactures the well-known Lincoln variable-speed motor, the success of which has required for its manufacture extensive additional quarters. It is the intention to make the new plant a model layout in every respect, and to use the shop as a showroom, showing the motors in operation.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED MARCH 22, 1910.

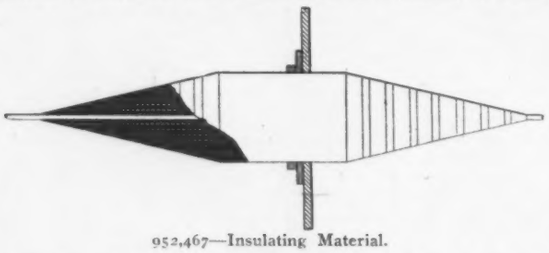
[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

952,448. INSULATING BUSHING; S. M. Kintner, Pittsburgh, Pa. App. filed Aug. 8, 1908. For high-potential circuits comprising alternate layers of insulating and conducting materials and round rod conductors into which the exposed ends of he conducing layers are merged.

952,467. INSULATING MATERIAL; A. B. Reynders, Wilkinsburg, Pa. App. filed July 6, 1908. Comprises alternate layers of insulating and conducing material which forms a series of condensers, the insulating layers being graded as to specific inductive capacity in accordance with their distances from the surfaces of the structure.

952,493. RAILWAY TRACK BRAKE; J. B. Atwood, Allegheny, Pa. App. filed Dec. 2, 1907. A stationary brake opened electrically; that is a track brake to operate to prevent the turning of the car wheels, the car wheel forming the armature of an electromagnet.

952,513. INSULATING MATERIAL; J. C. Dow, Wilkinsburg, Pa. App. filed July 5, 1907. An insulating bushing for high-potential circuits in which the wire is surrounded by a plurality of convolu-



952,467—Insulating Material.

tions of insulating material with separate convolutions of conducting material there-between forming condensers.

952,532. ALTERNATING-CURRENT MOTOR; W. A. Layman, Webster Groves, Mo. App. filed July 29, 1909. The motor starts as a series motor and operates as a self-excited shunt induction motor by means of a main inducing winding on the stator and a commutated winding on the rotor short circuited by the brushes with means for short circuiting a number of the turns of the winding after a certain speed has been reached, together with a second winding on the rotor on which a compensating electromotive force is impressed.

952,557. TELEPHONE MOUTHPIECE; A. K. Young, Pittsburgh, Pa. App. filed Aug. 4, 1909. Has a screw-threaded opening in the side having an antiseptic container in the form of a plug.

952,561. HIGH-TENSION MAGNETO GENERATOR; E. Denieport, Paris, France. App. filed May 23, 1908. An armature comprising primary and secondary windings, a circuit breaker for the primary winding and an annular condenser surrounding the shaft and connected with the opposite contacts of the circuit breaker.

952,566. ALTERNATING-CURRENT MOTOR; V. A. Fynn, London, England. App. filed June 1, 1909. Repulsion motor with a rotor having a fractional pole pitch winding short circuited by brushes and a stator having a mean winding and two auxiliary windings with means for cutting one or the other of the auxiliary windings out of operation.

952,567. TELEPHONE SYSTEM; D. S. Hulfish, Chicago, Ill. App. filed March 7, 1907. For party lines of the semi-automatic class using tone test devices normally connected to the answering equipment, thus disclosing the identity of the switching device associated with the tested line.

952,650. INDUCTIVE MOTOR-CONTROLLING DEVICE; A. Sundh, Yonkers, N. Y. App. filed July 17, 1907. For starting, stopping and reversing an alternating-current motor with differential field windings normally balanced together with a pilot motor and means for operating the latter by varying the inductance in its circuits, the main motor windings having their balance restored by varying the inductance.

952,681. AUTOMATIC MECHANICAL CUT-OFF FOR ELECTRICAL HEATING APPLIANCES; W. B. Matheson and I. D. Brodek, Los Angeles, Cal. App. filed Jan. 13, 1909. Automatically opens the circuit when the iron is placed in an inoperative position when it is turned on end by means of a longitudinal bar with a button that strikes the table when the iron is turned on end.

952,692. SPARK-COIL; C. H. Thordarson, Chicago, Ill. App. filed Nov. 17, 1908. A spark-coil with a cast-iron base and cast-iron casing, laminated core with air gaps between the ends of the core and the base and a low-resistance coil surrounding the core.

952,698. MEANS FOR OPERATING ELEVATOR DOOR LOCKS; J. E. Boyce, New York, N. Y. App. filed July 11, 1905. A single push-button controlled electric elevator with automatic means for preventing an elevator car from being moved until all hatchway doors are closed and locked.

952,741. TESTING SET; C. A. Hoxie, Schenectady, N. Y. App. filed April 19, 1909. For locating grounds and measuring insulation by means of a resistance box containing the resistances, batteries, current detectors grouped about a master key and arranged to make the four important tests by simply throwing the key.

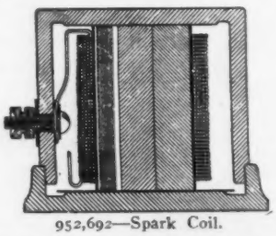
952,760. ELECTRIC IGNITER FOR EXPLOSIVE SHELLS; P. Schwenke, Zerbst, Germany. App. filed July 23, 1908. For exploding shells when they touch water by means of an electric explosive cartridge and a galvanic element adapted to be excited by the entrance of water.

952,778. ELECTRICALLY OPERATED MEANS FOR PRODUCING MECHANICAL MOVEMENTS; M. J. Wohl, New York, and H. Hertzberg, Brooklyn, N. Y. App. filed March 20, 1908. Makes use of electrically heated wire having one end attached to a rotary member and the other fixed so as to operate it.

952,842. METHOD FOR PURIFYING WATER; J. Roche and A. Oliver, New York, N. Y. App. filed Aug. 13, 1909. Slowly passes water through a filter, the material being interposed between a plurality of dissimilar metallic elements and affording a resistance to the flow of electric current, the water constituting the electrolyte of a primary battery.

952,899. INDUCTANCE NEUTRALIZING COIL WOUND CORE AND COMMUTATING IMPEDANCE COIL FOR ELECTRIC MACHINES; W. E. Goldsborough, La Fayette, Ind. App. field Dec. 22, 1902. A coil wound core, together with the armature for increasing the impedance during the time of the commutation without increasing the inductance of the circuits of the armature.

952,941. ELECTRIC HEATER AND COOKING APPARATUS; F. C.



952,692—Spark Coil.

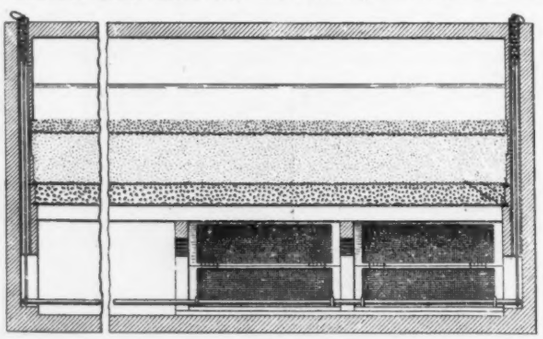
Perkins, Buffalo, N. Y. App. filed May 10, 1909. A cylindrical base, an electric lamp thereon, a reflecting collar, a metal shell enclosing the lamp constituting a steaming chamber and adapted to contain water, and a water storage chamber communicating therewith. For domestic use.

952,944. APPARATUS FOR TRANSMITTING SIGNALS OVER TELEGRAPHIC CIRCUITS; L. M. Potts, Baltimore, Md. App. filed June 5, 1908. A plurality of sources of alternating half waves, a commutator with means for making it to cause one of said sources to send only modified or reversed half waves to the line.

952,952. ATTACHMENT PLUG; F. E. Seeley, Bridgeport, Conn. App. filed April 13, 1907. An attachment plug with enclosed fuses for incandescent lamps. Details.

952,961. ELECTRICAL PLUG RECEPTACLE; G. B. Thomas, Bridgeport, Conn. App. filed Sept. 9, 1909. A flush plug receptacle to receive plugs of a circuit and having an insulating body with a hole through it and a metal contact tube in the hole.

952,991. AUTOMATIC STOP AND REVERSE MECHANISM; D. D. Hungerford, Elmira, N. Y. App. filed July 22, 1909. An electrically controlled motor-driven stop and reversing mechanism for use in



952,842—Method for Purifying Water.

thermostatic dampers and the like. Makes use of a motor-driven mangle wheel and an electric circuit and switch actuated by the mangle wheel at the end of each oscillation to open the circuit and stop the motor.

952,999. WATER GAGE; J. Torok, Renovo, Pa. App. filed Nov. 29, 1909. A water gage with two separate signals for sounding an alarm when the water in the boiler has reached certain levels.

953,006. AUTOMATIC CONTROLLING SWITCH FOR ELECTRIC MOTORS; R. L. Guion and B. C. Johnson, Elmira, N. Y. App. filed Nov. 9, 1908. The motor runs a given number of revolutions in both directions and is set in motion by a circuit-closing device located at a distance from the motor, as in thermostatic damper regulating devices.